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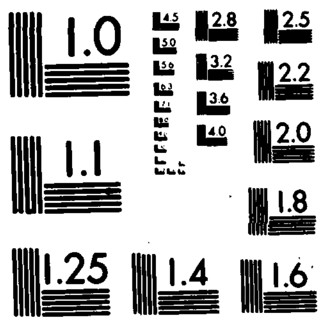

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MICROTERMINAL/MICROFICHE SYSTEM FOR COMPUTER-BASED INSTRUCTION: HARDWARE AND SOFTWARE DEVELOPMENT

By

James P. Kottenstette
Dale A. Steffen
Denver Research Institute
University of Denver
Denver, Colorado 80208

Joseph P. Lamos

LOGISTICS AND TECHNICAL TRAINING DIVISION
Technical Training Branch
Lowry Air Force Base, Colorado 80230

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This report has been reviewed by the Office of Public Affairs (PA) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

ROSS L. MORGAN, Technical Director
Logistics and Technical Training Division

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The development of the Air Force Human Resources Laboratory Microterminal/Microfiche System is an effort to combine microprocessor technology with microfiche medium to provide a low cost system for the delivery of technical training with a capability to function in the broader scope of computer-based instructional environments, including both computer-managed instruction and computer-assisted instruction. The system is composed of four major components and associated interfaces. The major components are (a) microterminal, (b) microfiche reader, (c) memory module, and (d) hardware interface between the microterminal and the microfiche reader. The microterminal is the result of a previous effort and was developed to support stand-alone, off-line testing. The microfiche reader is an off-the-shelf unit and

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is adapted to allow sensing of the position of the platen containing the microfiche so that frame locations can be verified by the microterminal software. The memory module is portable and removable from the microterminal which provides an interface to a larger computer-based instruction system. The microterminal can support various levels of testing and has already been successfully demonstrated in a technical training environment. The interface between microterminal and microfiche consists of linear position transducers on the microfiche unit and control circuitry in the microterminal to provide platen position sensing and additional circuitry to allow software control of the projection lamp. A demonstration of the microterminal/microfiche system has been successfully performed supporting testing functions in technical training. The demonstration showed that the microterminal is a preferred technology for recording student responses during testing and that the microfiche presentation of test items is an effective medium.

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SUMMARY

The microterminal/microfiche (MT/MF) system development is part of a continuing effort to investigate the feasibility of a low-cost, stand-alone device for the delivery of the testing component of technical training in a computer-based instructional (CBI) environment. The objective of this effort was to develop hardware and computer software to interface the Air Force's prototypic microterminal to an "off-the-shelf" microfiche unit, to develop materials on microfiche to support progression testing (the serial presentation of criterion-referenced test items), and to conduct a demonstration of the developed capability in a CBI environment. The results produced in attaining these objectives will guide the further development of MT/MF system capability to support selective testing and retesting, during the second phase of this research program, and ultimately, the development of adaptive testing capability utilizing a stand-alone configuration.

BACKGROUND

In a CBI system, a significant cost is associated with terminal hardware and its attendant support features. If a large computer-assisted instruction (CAI) component exists in a CBI system, significant terminal costs result from the requirement of dedicated terminals for each student. Unlike central site mainframe and communication costs which can be amortized across large numbers of students, CAI terminal costs are directly and linearly related to the absolute number of students supported. For computer-managed instruction (CMI), the proportionate cost of terminals can be amortized over large numbers of students as is done for the central site mainframe and communication, since students share terminals. However, CMI lacks the level of interaction provided by CAI at the lesson level and results in recurring costs associated with the use of computer forms and support materials.

Prior research has determined that use of a small, stand-alone, microprocessor-based terminal can support student activities in a broader CBI environment by providing a form of CAI in the context of CMI operations. Concurrent with earlier research, the feasibility of using microfiche as an alternative medium for the delivery of technical training was investigated to devise a microfiche system that met administrative and production criteria in addition to instructional media criteria. The result of that investigation brought the power of computer output microfilm (COM) to bear directly on the problems of producing, updating and revising instructional materials while gaining the flexibility necessary to produce graphics consistent with content formatting requirements.

It was visualized that the combination of the microterminal and microfiche components would result in a stand-alone capability that incorporates the necessary elements of an interactive terminal, namely

information presentation, response handling, and data collection in low-cost configuration.

APPROACH

In order to achieve the combination MT/MF, a hardware interface was required between the two components in order for the microterminal to track each microfiche frame projected by the microfiche viewer. By incorporating instructional logic in the microterminal that was coordinated with the content format of the microfiche, the tracking capability provided by the interface offered a means for directing a student to specific information locations on the microfiche and recording student responses coordinated with frame locations. In addition to hardware development, basic control interface software was required for the terminal, as well as the design and initial development of editing software to aid in the production of instructional content that could be managed and controlled by the microterminal.

SPECIFICS

A detailed configuration specification was produced which guided the development of a prototype MT/MF system, which was demonstrated in a classroom environment that utilized CBI methods. Hardware components which allowed the integration of an existing "off-the-shelf" microfiche unit with the microterminal were developed and consisted of the addition of linear position transducers and control circuitry to sense the position of the platen containing the microfiche. In addition, circuitry was developed to allow software control of the projection lamp.

Ten prototype MT/MF units were produced for the purpose of demonstrating progression testing consistent with criterion-referenced testing objectives. Software, courseware, and production techniques were developed to allow for delivery of progression testing in a stand-alone configuration. The demonstration involved evaluation of three experimental student groups and a control group. Student performance was evaluated for the microterminal alone, the microfiche test format in hard copy, and lastly, the MT/MF system.

RESULTS AND CONCLUSIONS

The specific objectives of Phase I of the MT/MF development were achieved, and the demonstration of the technology showed that (a) the microterminal is a preferred technology for recording student responses during progression testing and (b) the microfiche presentation of test items is an effective medium---gauged by the students ability to use the COM produced test format.

The principal areas of improved CBI performance expected from incorporation of the MT/MF system are (a) the use of the mainframe computer in the production of courseware delivered by the microfiche component, (b) the use of alternative instructional functions, including

progression testing, selective testing, and adaptive testing and instruction,(c) increased test security and integrity of the testing process, (d) increased precision in the testing process, (e) reduced costs in the administration of tests, and (f) reduced costs in the delivery of adaptive instruction through student terminals.

I. INTRODUCTION

The development of an Air Force Human Resources Laboratory (AFHRL) Microterminal/Microfiche (MT/MF) System has been planned for three phases. This report documents Phase I - the development of the hardware, software, and courseware required to interface the Air Force microterminal with a microfiche viewer and then a demonstration of the operation of the combined units.

A. Background

Prior research has determined that use of a small, stand-alone microprocessor-based terminal can support student testing activities in a Computer-Based-Instructional (CBI) System such as the Advanced Instructional System (AIS) at Lowry AFB, Colorado. The concept of such an interactive testing terminal was first demonstrated by AFHRL at Lowry AFB in the period 1975-76 (Kirby & Gardner, 1976). The rationale for the concept was an outgrowth of an attempt to find an alternative to the large number of paper-and-pencil tests required for AIS implementation. With several thousand students attending technical schools supported by AIS at that time, the large volume of test forms presented a logistics problem, as well as a major expense item in the operation of the AIS.

Further research was conducted by AFHRL and the Denver Research Institute (DRI) during the period 1977-78 (Steffen, Gray, Wasmundt, and Lamos, 1978) to refine the design of the initial terminal and to perform further research on the utility of such a device in a CBI environment. The device tested is now referred to as the microterminal.

The microterminal is a desk-top unit not much larger than a standard 10-key adding machine. Its major design innovation is a plug-in memory module that records student responses for future retrieval. The microterminal keyboard and light-emitting diode (LED) readout are complemented by a series of LED indicators which step the student users through the proper test sequence, allow them to review or skip questions, and notify them when all items have been answered. At any time, a student may remove the module from the microterminal and return later without a loss of recorded data or student progression.

The research performed to date indicates that use of the microterminal as a substitute for computer-readable (mark sense) test forms provides an instructional and economic advantage. These results (Steffen et al., 1978) suggest that the speed and accuracy with which students complete a test are improved, and if an appropriate amortization period is considered, the capital investment in the microterminal would effect a savings over the recurring costs associated with the use of test forms.

The feasibility of using microfiche as an alternative medium for the delivery of technical training was investigated concurrently with the research effort on the microterminal (Kottenstette, 1979). The approach

taken in the investigation was to devise a microfiche system that met administrative and production criteria in addition to instructional media criteria.

This system called the dual-fiche concept, provides a way to separate the production of the text component of an instructional module from the production of the graphics component, and still combine or merge the two types of information at the point of use--the microfiche reader. This development brought the power of Computer Output to Microfilm (COM) to bear directly on the problems of updating and revising instructional materials while gaining the flexibility necessary to produce graphics (particularly color-intensive graphics) consistent with content formatting requirements. The dual-fiche concept should be understood as involving two transparencies, one with text and the other with graphics, including continuous tone color images if required. Images from each transparency are projected simultaneously, much as is done with complex viewgraphs having registered overlays that are projected together.

The purpose of the present effort is to combine the management and control capability of the microterminal with the information presentation capability of the microfiche to produce an interactive, stand-alone training system. In order to achieve this combination MT/MF, a hardware interface is required between the two components in order for the microterminal to track each microfiche frame projected by the microfiche viewer. By incorporating instructional logic in the microterminal that is coordinated with the content format of the microfiche, the tracking capability provided by the interface offers a means for directing a student to specific information locations on the microfiche and recording student responses. In addition to hardware development, basic control interface software is required for the microterminal as well as design and development of editing software to aid in the production of instructional content that is connected to COM microfiche and is, in turn, managed and controlled by the microterminal.

B. Objectives

The overall objectives of the three-phase effort are as follows:

1. Develop hardware and computer software to interface the Air Force prototype microterminal to an "off-the-shelf" microfiche unit to support at least the following capabilities:

    a. Progression Testing - the serial presentation of objective-type test items with capabilities to provide correction of answers, return to skipped items, and corrective feedback.

    b. Selective Testing - access of predetermined objective - type test items out of an item pool for measurement of a selected instructional objective or objectives and in-

corporating the same response capabilities provided for progression testing.

c. Adaptive Testing and Instruction - Presentation of objective-type test items and instructional content in a pseudo-random or branching manner determined by a computer-stored algorithm and providing the same response capabilities provided under progression testing.

2. Develop instructional courseware for the purpose of demonstrating the capability of the MT/MF system to support at least progression testing, selective testing, and adaptive testing and instruction.

3. Demonstrate, in the computer-managed instructional (CMI) environment of the AIS, the support of progression testing, selective testing, and adaptive testing and instruction through utilization of the MT/MF system.

The specific objective to be realized during Phase I, and the subject of this report, was the development of the MT/MF system hardware and the development of essential software and courseware to demonstrate the MT/MF system in support of progression testing. The following tasks were accomplished to achieve the objective of Phase I:

1. A detailed configuration specification for the MT/MF system development was produced.

2. Twenty microterminals were produced with a hardware capacity to support progression testing and non-microfiche supported, linear-sequenced instruction.

3. Hardware components were developed to allow the integration of an existing "off-the-shelf" microfiche unit with the microterminal.

4. Software was developed to support progression testing.

5. Ten prototype MT/MF system units (using existing microterminals) were produced for the purpose of demonstrating progression testing and subsequent capabilities.

6. Courseware and attendant techniques were developed to demonstrate the capability of the MT/MF system to support progression testing and to perform a demonstration of the capability.

The configuration specification of Task I has been produced as a separate document. However, because of the importance of this specification as a guide to the performed research and development, certain sections of the specification considered pertinent to the effort performed during Phase I, are reproduced in this report; Appendix A con-

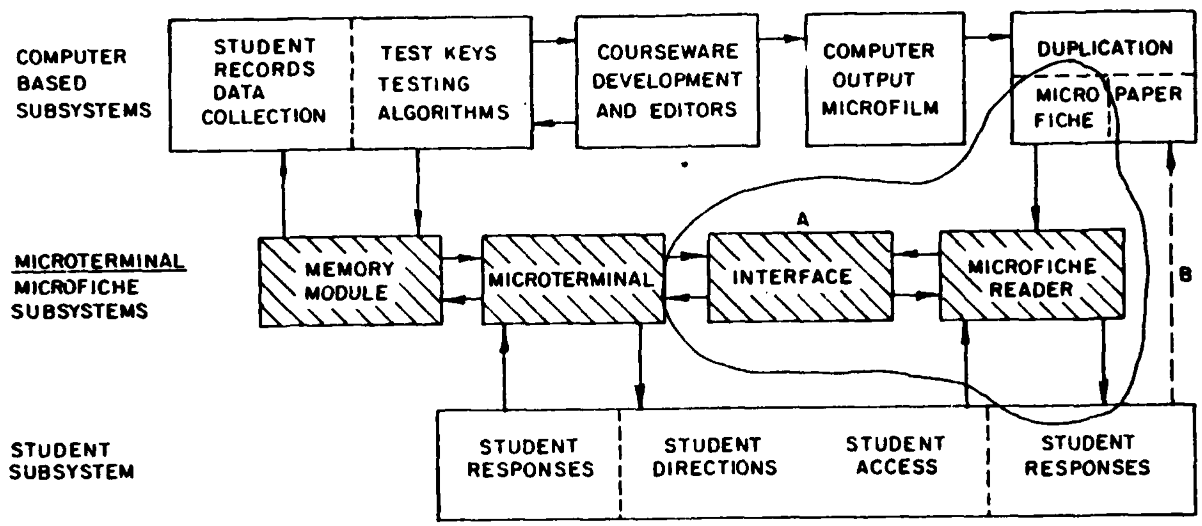
tains Sections 1 (Scope), 2 (Applicable Documents), and 3.1 (Requirements, Definitions) of the configuration specification. Some of the content of the specification also appears in the main body of this report.

C. Microterminal/Microfiche System Description

The MT/MF system is composed of four major components and associated interfaces. The major components of the system are (a) microterminal, (b) microfiche reader, (c) memory module, and (d) hardware interface between the microterminal and the microfiche reader. This hardware interface enables coordination of the information presented on the microfiche with the instructional strategy implemented and controlled by the microterminal. In addition to this MT/MF interface, a communication capability to the AIS, or other CBI system, is required to permit data transfer to and from the microterminal memory module. A third interface, a software/courseware interface, is required to effectively integrate the MT/MF system into the CBI system. While the third interface is not essential to system operation, its development as an AIS component ensures correspondence between directives given by the microterminal and the specific courseware and test material presented on the microfiche reader display. Block diagrams of the major system components and interfaces are illustrated in the configuration specification appended to this report.

The MT/MF system complements CBI systems, such as the AIS, by providing for (a) student response handling (microterminal), (b) courseware presentation (microfiche), and (c) data collection relative to the students' transactions on the MT/MF (memory module). The relationship between the MT/MF system components and the CBI system in which it is embedded is shown in Figure 1. Note that provision has been made for the delivery of courseware using paper-based or hardcopy materials in addition to the microfiche delivery medium. In this case, all verification functions provided by the interface between the microterminal and microfiche reader are accomplished by the "Student Subsystem." The shaded area of this figure represents the hardware configuration of the components; enclosure "A" represents the provisions for the MT/MF subsystem interaction with a CBI system when microfiche is being used for the delivery of courseware; and the dashed line "B" represents the provisions for this interaction when hardcopy materials are to be used as the courseware delivery medium. In the latter case, those components included in enclosure "A" are not present in the configuration.

Section II of this report addresses the hardware developed during Phase I, while Section III reviews the software development efforts, and Section IV discusses the developed courseware interfacing techniques. A demonstration of the MT/MF system took place in an institutional environment in which student performance and student attitudes were determined. The effectiveness of the MT/MF system as a function of Phase I characteristics was assessed in terms of administrative



NOTES: A = Primary configuration incorporating Microfiche as the medium for courseware.
B = Alternative configuration (hardcopy versions of courseware)

FIGURE 1. BLOCK DIAGRAM OF PRIME ITEM CONFIGURATION.

factors and training effectiveness. Section V contains a description of the demonstration, and concluding remarks along with recommendations for the continuing efforts are presented in Section VI.

II. HARDWARE

A. Basic Microterminal Configuration

The original testing device developed by AFHRL and referred to as a "student responder" consisted of a keyboard, several display elements and a column of individual message display lamps (Kirby & Gardner, 1976). The responder required continuous interaction with a large central computer--a costly and undesirable feature. A microcomputer was incorporated into a redesigned responder to provide a dynamic stand-alone capability. With this change the unit became known as the "microterminal." In 1976, DRI undertook a project to determine a hardware interface which would enable the microterminal to transfer data directly to the central site. The modifications made to the prototype to effect this change consisted of additional support circuitry, input/output (I/O) buffers, and several software changes (Wasmundt, Steffen, & Kargo, 1976).

A study conducted during 1977, identified further hardware and software features which placed limitations on future applications of the device. Testing scenarios and security applications were limited, and there was no capability to communicate with other external components, such as a microfiche projector, an external memory, or similar devices. The study resulted in a project to incorporate three major changes in the prototype microterminal. These were the inclusion of an external parallel I/O connector with associated electronics, the addition of an external memory module and incorporation of a power supply unit (Steffen et al., 1978).

These development efforts resulted in a microterminal not much larger than a 10-key adding machine, whose major design characteristics included student answers for future retrieval, a keyboard for student inputs and an LED readout complemented by a series of LED indicators. These indicators step the students through the proper test sequence, allow them to review and skip questions, and notify them when all items have been answered. At any time, a student may remove the module from the microterminal and return later without loss of answered items or change in sequence. Also included in the microterminal are a group of colored indicators which may be used for adaptive instruction and testing. This basic configuration set the stage for research into hardware components which would interface the microterminal to a microfiche projector. It was apparent that in addition to necessary connectors and circuitry, modifications would have to be made to the microfiche projector to provide a means of correctly positioning and calibrating the images to be viewed.

B. Component Modifications

The microfiche viewers selected for these modifications were the Micro-Design 4010 and 4020 models manufactured by Micro-Design. These viewer models are identical except for their viewing screen size.

The modification consists of the addition of linear potentiometers to sense the position of the microfiche platen in both the X and Y directions, and a solid-state relay to control the projection lamp. A cut-away drawing in Appendix B, shows the location and mounting of the brackets and wipers for these potentiometers.

A printed circuit board is used to mount the solid state relay that controls the 110 VAC to the viewer and to mount the variable resistors used to establish "set points" on the potentiometers and, in effect, to calibrate the system. The I/O connector that connects the viewer to the microterminal is also mounted on this board. The cut-away drawing also shows the mounted position of this board in the viewer base. A 14 conductor ribbon cable connects the viewer to the adaptor module in the microterminal.

The adaptor module is designed as a plug-in unit that is plugged into the memory module socket of the microterminal. Back-to-back plug and socket connectors allow the memory module to be plugged into the terminal in the same manner as in normal operation. This allows a microterminal to be used with the microfiche viewer without any physical changes required to the microterminal. Tables 1 and 2 in Appendix B detail the parts used to modify the microfiche reader. A detailed cost analysis of the adaptor module and microfiche viewer modifications will not be conducted until it is certain the present design is suitable.

C. MT/MF Interface Description and Operation

Figures 2 and 3 show block diagrams of the MT/MF interface circuitry used to establish the proper position for the microfiche carrier. When the carrier is properly positioned, the lamp and fan will come on and the student can observe the courseware or test material identified by the microterminal LED readout.

R_X and R_Y are linear potentiometers (position transducers) installed in the viewer during the component modification. Wipers are installed to sense the position of the carrier with respect to an extreme end position. Resistors are used to adjust the maximum and minimum voltages that result when the carrier is at an extreme XY position. Thus, voltage through the potentiometer varies with the position of the carrier.

The adaptor includes an analog-to-digital (A/D) converter. The converter changes the analog form of the voltage signal to the digital equivalent.

The microterminal may inform the student, for example, that question #1 for a test is located at X, Y coordinates G-7 on the microfiche frame. The microterminal also saves the digital representation of these coordinates for later comparisons. Power to the microfiche lamp is controlled at the microterminal I/O bus and at this time the lamp is out. "Analog Select" and "Start Convert" signals are

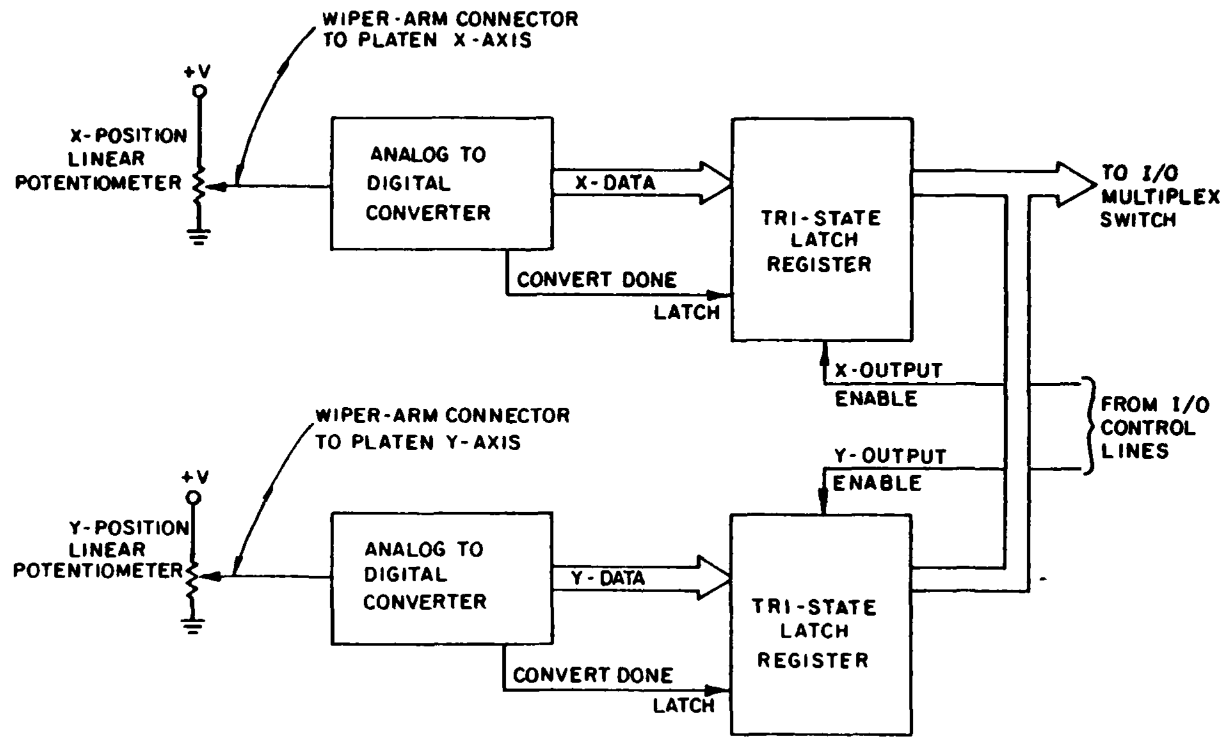


FIGURE 2. BLOCK DIAGRAM OF PLATEN X & Y POSITION TRANSDUCERS.

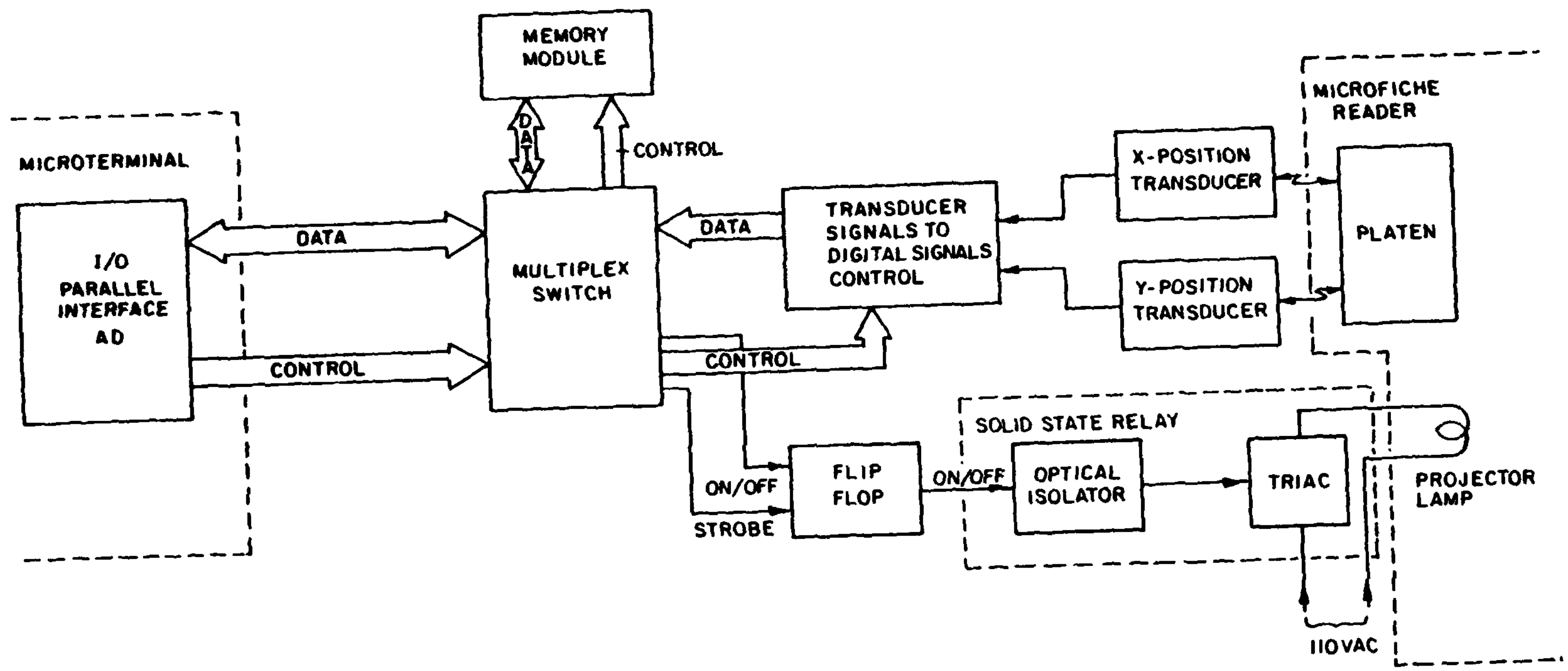


FIGURE 3. BLOCK DIAGRAM OF MICROTERMINAL/MICROFICHE INTERFACE

transmitted from the microterminal to the A/D converter. The start signal initiates a clock which alternates selection of the X and Y voltage output and converts the voltages to digital coordinates.

When a match of both the X and Y coordinates is found, the circuit to the microfiche lamp is completed, the lamp comes on, and the student can read the question.

Through this process coordination is maintained between the question number shown on the microterminal and its location on the microfiche platen.

Appendix C provides the logic network and schematic layout of the circuitry and a technical description of the adaptor module. Included is a discussion of the calibration procedure that is used to match individual microterminal and microfiche parameters.

III. SOFTWARE

The software development for this phase was divided into two parts. This was done so that the progression testing program could be evaluated separately from the microfiche control program.

A. Progression Testing Support

The progression testing program consists of four test types which include the following modes of operation:

Type 1. Provision for no answer feedback, ability to skip items, ability to correct answers.

Type 2. Provision for correct answer feedback, ability to skip items, and no correction of answers after feedback.

Type 3. Provision for indications of incorrect answer feedback until correct answer is given, ability to skip items, and no correction of answers after feedback.

Type 4. Provision of feedback of correct answers delayed until end of test, ability to skip items, and ability to correct answers until initiation of delayed feedback.

The development of software to implement each of these modes of progression testing ensured that the microterminal could be utilized independently in CBI applications. That is, student responses could be recorded for any of the four types of progression tests specified above without regard to the medium used to present the test questions to the student or user. For example, to deliver Type 3 Progression Testing using a controlled test booklet, the test booklet number would simply be entered in the microterminal via the keyboard, and the software would interpret the booklet number for the test type to be implemented in addition to other administrative data. This software development effort was largely an extension of the work reported earlier (Steffen et al., 1978).

B. Microfiche Control Software

When a microfiche presentation of progression testing materials is used in conjunction with the microterminal (the most rudimentary requirement met by microterminal software), in addition to administering a particular test type, the projection lamp in the microfiche viewer must be controlled. If it is considered that more than one test or test version will be recorded on the microfiche (a practical example is found in Air Training Command Residence Courses in which Block Tests for criterion-referenced objectives typically have between 20 and 40 test items while the fiche may hold several hundred such items), it will be apparent that only the prescribed test or test version should be accessible to the student. The microfiche control software that was devel-

oped provides the means for illuminating only that portion of the microfiche containing the prescribed test or test items by utilizing the fiche position monitoring capability of the microterminal logic.

For purposes of the MT/MF demonstration, control software was developed which provided access to only one of the test versions recorded on microfiche. Each test version was formatted so that it occupied one-third of the information area available on the fiche (the fiche format is described in more detail in Section IV-Courseware Interface). Thus, the control software was designed to allow only the prescribed test version to be illuminated, again based on the Block Test version number keyed into the microterminal (which for purposes of demonstration also specified that type 1 progression testing was to be employed). Figure 4 illustrates the fiche layout for the three test versions used in the demonstration. It should be noted that the development of control software has not proceeded to the point where an individual frame location on the fiche can be specified on the microterminal display (on a pseudo-random basis) and the screen is illuminated only when that particular frame location is accessed by the user using the frame coordinates displayed on the microterminal and the fiche index grid on the microfiche viewer. This control software development can be used to provide progression testing based on selection of items from a pool of test items developed for each instructional objective. This development should also be considered as a prerequisite for implementing selective testing on the MT/MF, an objective of Phase II in this research program.

Functional flow diagrams of the software developed for Phase I are given in Appendix D. The flow diagram for lamp control used in the demonstration progression tests is designated as test type 5, and the flow diagram for selected frame progression testing is designated as test type 6 in the Appendix.

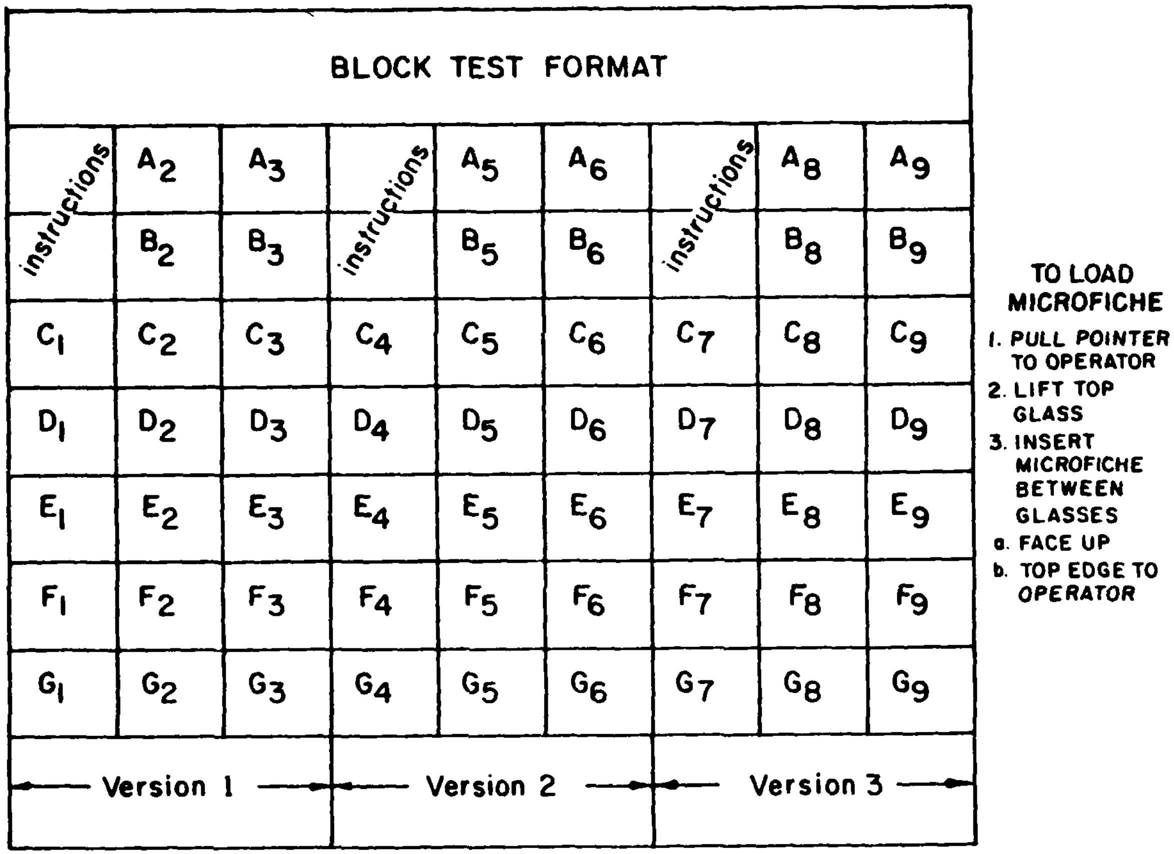


FIGURE 4. BLOCK TEST FORMAT

IV. COURSEWARE INTERFACE

The Computer Output to Microfiche (COM) Graphics Editor, as described in the configuration specification, has been implemented as the CAMIL (Computer Assisted, Managed Instructional Language) program EDITFICHE to provide maximum fit with the various components of the AIS. The program flow of EDITFICHE is shown pictorially in Figure 5. At this time, only Program Segments 1, 4, and 5 are operational. A detailed description of the program flow for EDITFICHE is presented in Appendix E.

In order to illustrate the functions of the COM Graphics Editor development plan, it will be useful to describe the prototype courseware development effort that resulted in both the hardcopy and microfiche test versions that were used in the demonstration of progression testing during Phase I. The design and production of these materials served to clarify what steps should be taken to capture the courseware development capability of the AIS system and bring it to bear on the routine production of materials for the MT/MF system.

A. Design Considerations

Figure 6 presents an example of test questions and associated graphics taken from a booklet of test items prepared for the MT/MF demonstration. The hard copy illustration introduces basic questions or considerations that shaped the COM Graphics Editor development. These considerations are:

1. How can text and graphics be routinely merged within a frame?

2. What constitutes an effective format for presentation of instructional content via microfiche?

3. How can the microterminal response handling capability be keyed with "correct" responses or other directives displayed on the microfiche viewer?

These considerations touch on basically different design issues. The first consideration is embedded in a larger question related to production, costs, and technology. The second consideration is really one of instructional design principles involving trade-offs between instructional objectives, media selection, and the characteristics of the training environment and infrastructure. Finally, the ability to coordinate between the information being formatted for display and the response handling capability of the microterminal is a special case of analyzing the particular CMI system design. The common denominator for rationalizing these design issues has been to improve the courseware development capability of the AIS and initiate practical solutions to the design questions peculiar to the AIS.

Figure 7 shows the prototype dual-fiche developed in response to the courseware design issues and requirements for demonstration/

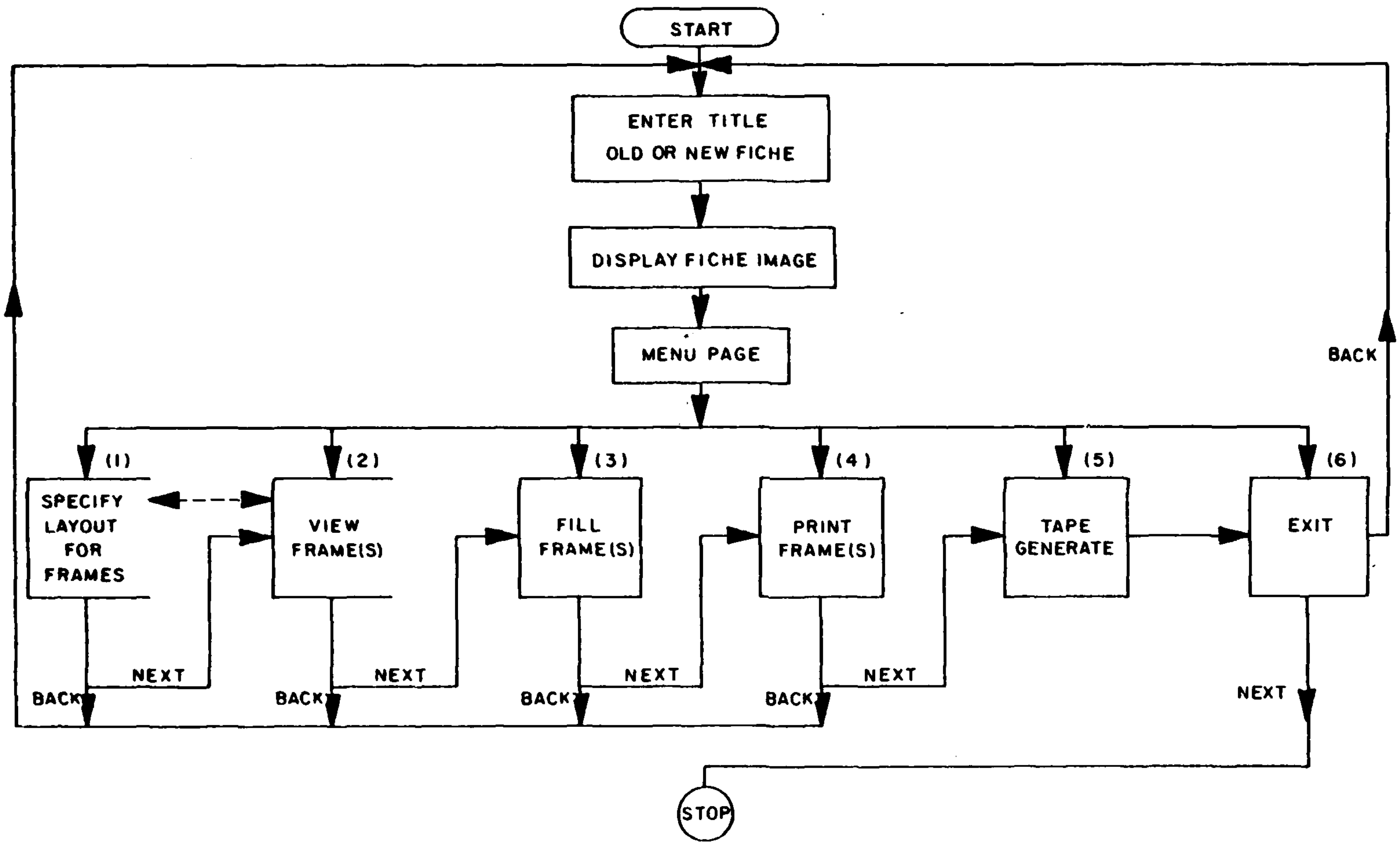
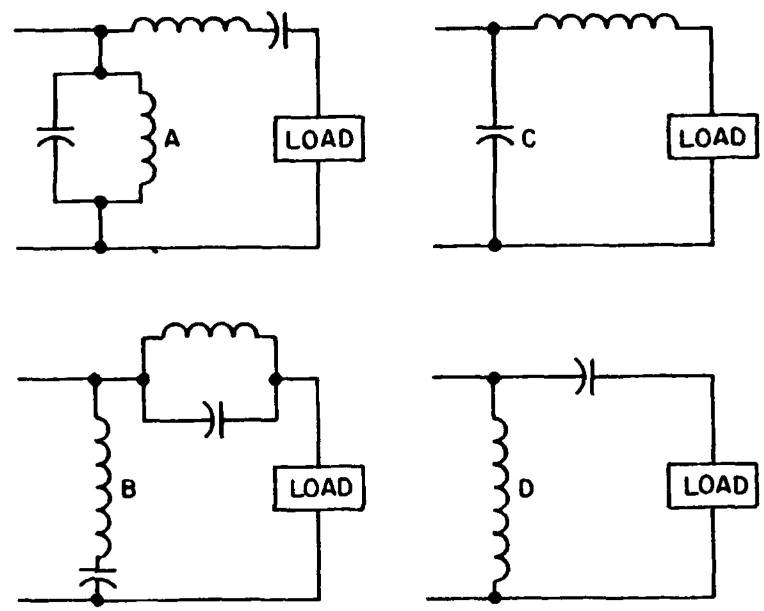


FIGURE 5. PROGRAM FLOW DIAGRAM FOR EDITFICHE (PROGRAM SEGMENTS 1 THRU 6)

QUESTION 25. (BLOCK II: 02-006-03, POI OBJ. 5d).
WHICH OF THE FOLLOWING IS A BAND PASS FILTER ?

a. A
b. B
c. C
d. D
e. –



QUESTION 26. (BLOCK II: 02-006-03, POI OBJ. 7b).
WHAT IS THE VALUE OF THE PRIMARY CURRENT IN THE CIRCUIT SHOWN ?

a. 167 ma
b. 360 ma
c. 500 ma
d. 1 amp
e. 1.5 amp

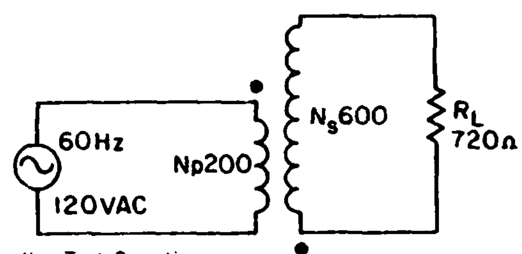


Figure 6. A Hardcopy "Frame" of Demonstration Test Questions.

The text portion was generated using COM Graphics Editor capability: The circuit diagrams were originally hand-drawn. The composite frame was made by photocopying an overlay of the respective inputs.

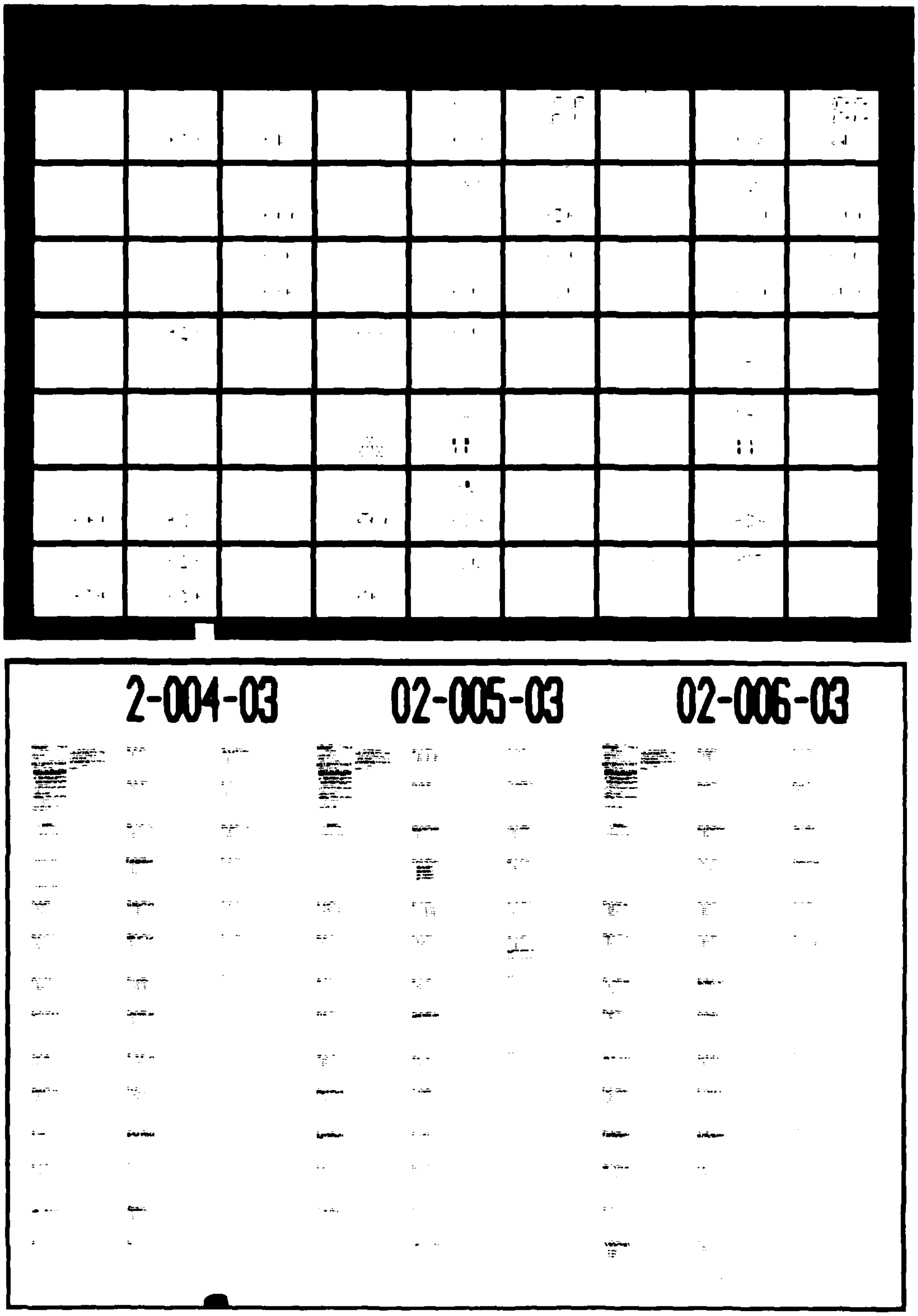


Figure 7. Prototype Microfiche: The upper transparency contains the graphic component of each frame, the lower transparency contains the text component. Graphics were recorded with a step-and-repeat camera.

evaluation of progression testing. The two films that have been photocopies in Figure 7 are physically registered emulsion to emulsion and, when used in a viewer, produce a composite image of both the text and the graphics. The image so produced is shown in Figure 6 as it would appear on the viewing screen. This technique allows for a logical separation between the production system used to produce text and the system used to produce graphics.

Preparation of the text portion of each frame relies on the text editing capability of the AIS and the format of the information demonstrates the need for a text manipulation capability within the COM Graphics Editor in order to "reserve" areas within frames for illustrations and/or graphics. Similarly, the choice of presenting two questions per frame (instead of perhaps, one or three) illustrates the options available in formatting a microfiche to accommodate specific types of information. The format of the microfiche shown in Figure 7 reflects a balance among administrative considerations (e.g., all block test versions available on one microfiche to improve test security and handling convenience), human factor considerations (e.g., the test items are presented sequentially in columnar format) and editorial considerations (e.g., a change in criterion-referenced objectives necessitates revision of all three test versions). The particular microfiche format developed here for the demonstration of progression testing represents only one format option: in other applications, different format options can be expected to provide the necessary balance between design considerations (Kottenstette, 1979). The capability to select between format options and to implement new format options is part of the COM Graphic Editor development.

In completing the planning for production of the prototype for demonstration , it was necessary to know only which questions would be recorded in a specific frame and which responses were correct responses for the questions. With this information, the read-only memory in the microterminal could be programmed in advance to ensure correspondence between the information displayed and the programmed intelligence in the microterminal. In order to ensure coordination between the information displayed and the microterminal operation when new materials are prepared, the development of the courseware editor will include the use of an algorithm computed from information contained in each test identifier (currently the test booklet number). The algorithm will specify the location of the correct answer within the array of distractors for each question during fiche editing, as well as during microterminal programming. The answer array can be generated and stored in microterminal memory on a test-by-test basis.

V. MICROTERMINAL/MICROFICHE SYSTEM DEMONSTRATION/EVALUATION

The MT/MF system was evaluated during the Precision Measuring Equipment (PME) Course at Lowry AFB, Colorado. The PME Course is supported by the AIS which is a large computer-based training system developed by McDonnell-Douglas Corporation under contract to the Air Force Human Resources Laboratory.

The PME Course provides individualized instruction in meteorology and electronics. In an earlier study dealing with the development and evaluation of the microterminal itself, Steffen et al., (1978) discovered that students who utilized the microterminal for the purpose of recording answers to an end-of-block criterion examination had higher test scores than did students who continued to use computer-readable test forms for recording their answers. The test score differences were both statistically significant and unexpected. Additional analysis of these results indicated that the use of the microterminal contributed to the ability of students to concentrate on taking their test. Part of the present evaluation, in addition to evaluating the acceptance of the MT/MF System, was to attempt to replicate these earlier findings.

The evaluation of the MT/MF System occurred during a period from 18 July 1979 to 1 October 1979. Three experimental groups and one control group were established. The first experimental condition for Group One (G1) was the same as that established in the earlier microterminal evaluation; that is, the microterminal was utilized with a regular printed test booklet providing the presentation of test items.

The second experimental group (G2) was really a control condition for the subsequent experimental condition in which a microfiche and viewer/reader would be the medium of presentation. This second group utilized the microterminal in conjunction with a paper test booklet in which each page was formatted in the same manner as would occur on the microfiche itself. Recent studies by the Navy (Graham & Johnson, 1979) have indicated that use of microfiche slows down completion rate in instruction and testing. The second experimental group along with the first group would serve to provide sufficient baselines against which it could be determined whether or not use of microfiche in and of itself slows down student performance.

The third experimental group (G3) utilized the microterminal in conjunction with a microfiche reader. As explained earlier, the microterminal was connected physically to the microfiche reader and controlled access to the appropriate area of the microfiche through control of the projection lamp in the microfiche viewer. This control is provided through a location detection system added to the platen of the microfiche reader. A student after accessing the prescribed test version on the microfiche had access to all items in the test version and could access them in any order just as can be done with a pencil-and-paper test.

The control group consisted of a sample of students tested during the same time period as the experimental conditions. Since there were only

two microterminals and/or MT/MF systems available, some students were not able to participate in the experimental conditions. Subjects were assigned to a particular condition on a first come basis. In addition to the limited availability of equipment, another factor was the certain degree of self-selection exercised by students. Some students who would have been able to use the experimental equipment elected not to do so. This aspect is discussed in more detail later.

Three major areas of concern were evaluated. The first was to see if the use of the microterminal had a positive effect on test-taking behavior, as had been discovered in a previous evaluation of a Weapons Mechanic Course at Lowry AFB. The more difficult subject matter of the PME course, plus the different student population, provided a good set of conditions for a cross-validation of the previous findings. In regard to the student population, students in the PME course tend to be older and are often cross-trainees; i.e., personnel who have been in the service but who are changing career fields. The general aptitude of the students is also higher because of more restrictive entrance requirements. In the previous study (Steffen et al., 1978), students who used the microterminal for recording their test item responses averaged seven points higher than did students who used mark-sense computer forms. There was random assignment to condition, and an analysis of covariance (ANCOVA) was performed. Student comments led the investigators to the conclusion that the microterminal enhanced concentration during testing.

Table 1 presents the means and standard deviations for the dependent variables (Block Time, Block Score, and Test Time) across conditions. Tables 2 to 4 provide the ANCOVA results for each of the dependent variables with the covariates being pre-assessment measures that are predictive of student performance in the PME Course. These covariates are: VAR 3-Reading Vocabulary, VAR 4-Reading Score, VAR 5-State Anxiety Score, VAR 6-Current Grade, and VAR 7-Experience in Self-Paced Instruction.

In addition to the pre-assessment variables which serve as covariates, Block Time (completion time) is an indicator of student aptitude in a mastery learning environment such as exists in the PME/AIS learning centers. If the microterminal or the MT/MF System had a positive or facilitating effect on test-taking behavior, then it would be expected that the groups using either the microterminal or the MT/MF System would have significantly higher block scores than did the control group but would show no difference in block completion time. Table 2 shows that there was no significant difference in block completion time, and Table 3 shows that there were no significant differences in block scores for the four conditions. These results indicate that the facilitating effect of the microterminal found in the Weapons Mechanic Course was not upheld in the PME environment.

The second major area of concern was whether or not the new technology of the MT/MF System would have an inhibiting effect on student

Table 1. Means and Standard Deviations for Dependent Variables and Condition

	GØ (n=25)	G1 (n=28)	G2 (n=23)	G3 (n=26)
Block Time				
X	588 min.	606 min.	553 min.	603 min.
SD	167 min.	151 min.	234 min.	183 min.
Block Score				
X	78%	78%	83%	79%
SD	15	14	9	13
Test Time				
X		80 min.	82 min.	80 min.
SD		14 min.	16 min.	12 min.

Table 2. ANCOVA for Block Time and Condition

SOURCE OF VARIATION	SUM OF SQUARES	DE	MEAN SQUARE	F	SIGNIF OF F
COVARIATES	593826.327	5	118765.365	4.006	.002
VAR 3	163050.962	1	163050.962	5.500	.021
VAR 4	75459.727	1	75459.727	2.545	.114
VAR 5	8824.111	1	8824.111	.293	.587
VAR 6	110436.394	1	110436.394	3.725	.057
VAR 7	5033.245	1	5033.245	.170	.681
MAIN EFFECTS	27705.677	3	9235.226	.312	.817
VARI	27705.677	3	9235.226	.312	.817
EXPLAINED	621532.503	8	77691.563	2.621	.012
RESIDUAL	2757194.840	93	29647.256		
TOTAL	3378727.343	101	33452.746		

Table 3. ANCOVA for Block Score and Condition

SOURCE OF VARIATION	SUM OF SQUARES	DE	MEAN SQUARE	F	SIGNIF OF F
COVARIATES	4739.743	5	947.949	7.441	.001
VAR 3	2754.206	1	2754.206	21.620	.001
VAR 4	102.857	1	102.857	.807	.371
VAR 5	2.140	1	2.140	.017	.987
VAR 6	164.038	1	164.038	1.288	.259
VAR 7	386.864	1	386.864	3.037	.085
MAIN EFFECTS	242.171	3	80.724	.634	.595
VARI	242.171	3	80.724	.634	.595
EXPLAINED	4981.913	8	622.739	4.888	.001
RESIDUAL	11847.577	93	127.393		
TOTAL	16839.490	101	166.629		

Table 4. ANCOVA for Test Time and Condition

SOURCE OF VARIATION	SUM OF SQUARES	DE	MEAN SQUARE	F	SIGNIF OF F
COVARIATES	1404.419	5	280.884	1.535	.190
VAR 3	215.473	1	215.473	1.178	.282
VAR 4	680.796	1	680.796	3.721	.058
VAR 5	51.990	1	51.990	.284	.596
VAR 6	3.798	1	3,798	.021	.886
VAR 7	7.925	1	7.925	.043	.836
MAIN EFFECTS	174.208	2	87.104	.476	.623
VARI	174.208	2	87.104	.476	.623
EXPLAINED	1578.627	7	225.518	1.232	.297
RESIDUAL	12625.451	69	182.978		
TOTAL	14204.078	76	186.896		

performance reflected in either block score or test taking time. As already indicated, previous studies (Graham & Johnson, 1979) of microfiche use in Navy training found that the format and use of microfiche readers increased student completion times. Group 2 serves as a special baseline in addition to the control group (GO) and Group 1 which simply used the microterminal with a normal test booklet. For Group 2, the paper test booklet was reformatted such that test items appeared as they would when microfiche is used to present the test items. If the use of microfiche and its attendant reader is difficult to use because of human factor reasons, then it would be expected that block score and/or test time would be negatively affected for Group 3 in comparison to Group 2 and also in comparison to Groups Ø and 1. The results shown in Tables 3 and 4 do not show a significant effect on either block score or test time because of the use of the MT/MF System. The net result in terms of student performance was that the technologies of the microterminal or the MT/MF System were neutral in their effect on student performance.

The effect of student attitudes comprised the third area of concern. Figures 8 to 10 report the findings regarding student attitudes toward the microterminal and the MT/MF System for each of the three experimental conditions. As was found with the previous evaluation of the microterminal in the Weapons Mechanic Course, the majority of students preferred the use of the microterminal to the mark-sense computer test forms for the recording of student answers. Additionally, as items 11 through 16 in Figure 10 indicate, students had a strong preference for the MT/MF System in the test-taking environment.

The fact that the use of the microterminal in the PME Course did not have a positive effect on block test scores as had occurred in the previous Weapons Mechanic Course study can partially be explained by the responses given to items 6 and 12 on the student questionnaire. In the previous study, it was hypothesized that use of the microterminal minimized recording errors typical of the mark-sense computer forms and that this was a result of enhanced concentration when answering the test items. Table 5 gives the percent response to items 6 and 12 for all three PME experimental groups plus the previous results from the Weapons Mechanic Course. The Weapons Mechanic students indicated to a much larger degree than did the other groups a preference for the microterminal over computer test forms, and they stated that the microterminal aided their concentration on answering test items.

As mentioned before, the students in the PME course tend to be older because many of them are retrainees from other career fields, and they are selected on the basis of higher aptitude criteria for course entry. For students (mature trainees), it can be speculated that recording errors are not as common or that the ability to concentrate on test items is not as variable as found with Weapons Mechanic trainees. The present findings, as compared with the previous findings in the Weapons Mechanic Course, reflect the well known fact that the more experienced and higher aptitude people are more adaptive and accommodating in their behavior.

Table 5. Percent Responses to Student Questionnaire Items

Item Response	Weapons Mechanic*		PME Group 1		PME Group 2		PME Group 3	
	#6	#12	#6	#12	#6	#12	#6	#12
Yes	88%	81%	48%	66%	48%	64%	52%	63%
No	0%	19%	14%	34%	17%	36%	18%	37%
No Difference	12%	--	38%	--	35%	--	30%	--

*Data from Steffen et *al.*, 1978.

Figure 8

STUDENT QUESTIONNAIRE

Microterminal Use
(Group 1-Microterminal Only)

1. What is your opinion of the microterminal?

   89.3 Good   10.7 Bad   0 Indifferent

2. Which would you rather use for answering test questions throughout the rest of the course?

   86.2 Microterminal   13.8 Computer Test Form

3. Did you feel nervous using the microterminal? 7.2 Yes 92.8 No

4. Was the microterminal difficult to use? 17.5 Yes 82.8 No

5. Did you feel that you were restricted by the microterminal, as compared to a test form, in the way you could answer test questions? 17.2 Yes 82.8 No

6. Over the length of the course do you think that you would have less problems using the microterminal and its memory module than computer test forms? 46.3 Yes 13.2 No

7. Were the directions indicated by the lighted messages on the microterminal hard to follow? 0 Yes 93.1 No

   6.9 Marginal

8. Was the display area of microterminal easy to read?

   96.6 Yes 3.4 No

9. Was using the memory module at the management terminal as easy as using a test form? 86.2 Yes 13.8 No

10. In the space below, please indicate any other comments or suggestions you may have about the microterminal.

11. Did the microterminal make block testing seem easier to you?

69.0 Yes 31.0 No

12. By using the microterminal instead of a computer test form, for recording your test answers; did you feel that you were better able to concentrate on answering the test items?

65.6 Yes 34.4 No

13. What is the single thing about the microterminal which you either liked or disliked the most? Please answer below.

THANK YOU FOR YOUR COOPERATION

Figure 9

STUDENT QUESTIONNAIRE

Microterminal Use
(Group 2-Microterminal & Hardcopy Test)

1. What is your opinion of the microterminal?

   87.0 Good 4.3 Bad 8.7 Indifferent

2. Which would you rather use for answering test questions throughout the rest of the course?

   95.7 Microterminal 4.3 Computer Test Form

3. Did you feel nervous using the microterminal? 9.3 Yes 90.7 No

4. Was the microterminal difficult to use? 9.3 Yes 90.7 No

5. Did you feel that you were restricted by the microterminal, as compared to a test form, in the way you could answer test questions? 4.8 Yes 95.2 No

6. Over the length of the course do you think that you would have fewer problems using the microterminal and its memory module than computer test forms? 47.8 Yes 17.4 No

   34.8 No Difference

7. Were the directions indicated by the lighted messages on the microterminal hard to follow? 9.3 Yes 90.7 No

   -- Marginal

8. Was the display area of the microterminal easy to read?

   100 Yes 0 No

9. Was using the memory module at the management terminal as easy as using a test form?

   95.2 Yes 4.8 No

10. In the space below, please indicate any other comments or suggestions you may have about the microterminal.

11. Did the microterminal make block testing seem easier to you?

74.0 Yes 26.0 No

12. By using the microterminal instead of a computer test form, for recording your test answers; did you feel that you were better able to concentrate on answering the test items?

63.6 Yes 36.9 No

13. What is the single thing about the microterminal which you either liked or disliked the most? Please answer below.

THANK YOU FOR YOUR COOPERATION

Figure 10

STUDENT QUESTIONNAIRE

(Group 3-Microterminal/Microfiche)

1. What is your opinion of the microterminal/microfiche system?

   96.3 Good   0 Bad   3.7 Indifferent

2. Which would you rather use for answering test questions throughout the rest of the course?

   92.3 Microterminal   7.7 Computer Test Form

3. Did you feel nervous using the microterminal/microfiche system?

   25.9 Yes 74.1 No

4. Was the microterminal/microfiche system difficult to use?

   3.7 Yes 96.3 No

5. Did you feel that you were restricted by the microterminal, as compared to a test form, in the way you could answer test questions?

   7.4 Yes 92.6 No

6. Over the length of the course do you think that you would have fewer problems using the microterminal and its memory module than computer test forms?

   51.9 Yes 18.5 No

   29.6 No Difference

7. Were the directions indicated by the lighted messages on the microterminal hard to follow?

   3.7 Yes 96.3 No

   -- Marginal

8. Was the display area of the microterminal easy to read?

   92.6 Yes 7.4 No

9. Was using the memory module at the management terminal as easy as using a test form?

   96.3 Yes 3.7 No

10. In the space below, please indicate any other comments or suggestions you may have about the microterminal.

11. Did the microterminal/microfiche system make block testing seem easier to you?

70.4 Yes 29.6 No

12. By using the microterminal/microfiche system instead of a computer test form and test booklet did you feel that you were better able to concentrate on answering the test items?

63.0 Yes 37.0 No

13. Using the microfiche reader, was finding the test item you wanted easy?

85.2 Yes 14.8 No

14. Did you have trouble reading the test items on the microfiche?

14.8 Yes 85.2 No

15. Did you feel you could go back to previous test items using the microfiche as easily as you could with a test booklet?

77.8 Yes 22.2 No

16. Would you mind using a microterminal/microfiche system for the rest of your testing in the course?

7.4 Yes 92.6 No

17. What is the single thing about the microterminal/microfiche system which you either liked or disliked the most? Please answer below.

THANK YOU FOR YOUR COOPERATION

The conclusions that can be drawn from the present evaluation of the MT/MF System is that the microterminal is a preferred technology for the recording of answers to test items in a CBI environment and that the use of microfiche for the presentation of test items does not impose any problems for students in terms of their ability to perform.

VI. CONCLUDING REMARKS

The specific objective of Phase I, as outlined in Section 1 of this report, was met. The development and demonstration of the MT/MF System and courseware in support of progression testing should now be evaluated during sustained classroom operational use.

The principal areas of improved CBI performance expected from incorporation of the MT/MF System are as follows: (a) the use of the mainframe computer in the production of courseware delivered by the microfiche component, (b) the use of alternative instructional functions, including progression testing, selective testing, and adaptive testing and instruction, (c) increased test security and integrity of the testing process, (d) increased precision in the testing process, (e) reduced costs in the administration of tests, and (f) reduced costs in the delivery of adaptive instruction through student terminals.

It is believed that as the Phase I product is user evaluated and resultant lessons learned are applied to continued development during Phases II and III of this effort, each of the above areas of improved CBI performance will not only be realized, but final total acceptance of this technology can be anticipated by the user students and instructors.

VII. REFERENCES

Graham, L.L., & Johnson, K.A. Microficne and printed materials in individualized instruction: A comparison. NPRDC-TR-79-18. San Diego, CA; Navy Personnel Research and Development Center, May 1979.

Kirby, P.J., & Gardner, E.M. Microcomputer controlled, interactive testing terminal development. AFHRL-TR-76-66, AD-A035 731. Lowry AFB, CO: Technical Training Division, Air Force Human Resources Laboratory, October 1976.

Kottenstette, J.P. Microfiche applications for an individualized self-paced learning system. AFHRL-TR-79-6, AD-A069 445. Lowry AFB, CO: Technical Training Division, Air Force Human Resources Laboratory, May 1979.

Steffen, D.A., Gray, G.F., Wasmundt, K.C., & Lamos, J.P. Development of a low-cost, stand-alone microterminal for support of testing and instruction. AFHRL-TR-78-50, AD-A060 215. Lowry AFB, CO.: Technical Training Division, Air Force Human Resources Laboratory, September 1978.

Wasmundt, K.C., Steffen, D.A., & Kargo, D.W. Microterminal Inter-Evaluation: Interim Technical Report. DRI #2672, University of Denver, Denver Research Institute, Electronics Division, May 1976.

APPENDIX A

Configuration Specification
(Sections 1, 2, and 3.1)

CONFIGURATION ITEM PRODUCT FUNCTION SPECIFICATION FOR MICROTERMINAL/MICROFICHE SYSTEM DEVELOPMENT

1. SCOPE

1. SCOPE

1.1 This specification establishes the performance, design test, manufacture, and acceptance requirements for the Microterminal/Microfiche prime item.

1.2 CLASSIFICATION

Not applicable.

2. APPLICABLE DOCUMENTS

1. Lamos, J.P., Computer-Based Instruction: Instructional Design and Terminal Design. Paper presented at American Educational Research Association Annual Meeting, New York, 1977.

2. Steffen, Dale, Gray, G.C., Wasmundt, K.C., & Lamos, J.P., "Development of a Low-Cost, Stand-Alone Microterminal for Support of Testing and Instruction". AFHRL-TR-78-50. Lowry AFB, CO. Technical Training Division, Air Force Human Resources Laboratory, September 1978.

3. Planning Research Corporation, "Microfiche User Equipment Evaluation". C02935.01. McLean, VA: Planning Research Corporation, May 1978.

4. Kottenstette, J.P., "Microfiche Applications in an Individualized, Self-Paced Learning System". Lowry AFB, CO: Technical Training Division, Air Force Human Resources Laboratory. (In press).

3. REQUIREMENTS

3.1 ITEM DEFINITION

The item specified is composed of four major components which together will support testing and instructional applications in a computer-based instructional environment. The components of the item are: 1) A microfiche reader; 2) A microterminal; 3) A memory module; and 4) A device to interface the microterminal and the microfiche reader in order to coordinate the information presented to student users with the instructional strategy implemented (and controlled) by the microterminal. All components, with the exception of the microfiche reader, will be produced. The microfiche reader will be modified in accordance with requirements of the interface device, however.

The item, referred to as the microterminal/microfiche (MT/MF) system, relates to a computer-based-instructional system (such as the Advanced Instructional System--Reference 1) by providing for student response handling (microterminal); for courseware presentation (microfiche); and for data collection relative to the student's transactions on the MT/MF (memory module). The principle areas of improved CBI performance expected from incorporation of the MT/MF system are: 1) The use of the mainframe computer in the production of courseware delivered by the microfiche component; 2) The use of alternative instructional functions, including progression testing, selective testing, and adaptive testing and instruction; 3) Increased test security and integrity of the testing process; 4) Increased precision in the testing process; 5) Reduced costs in the administration of tests; and 6) Reduced costs in the delivery of adaptive instruction through student terminals.

The microfiche reader is an off-the-shelf component; the microterminal and its associated memory module have been prototyped (Reference 2); the interface device, to be incorporated in the microfiche reader and in the microterminal (not a stand-alone component) will provide verification of the fiche position through software control and control of the reader projection lamp. The necessary software to support the instructional functions will be developed as an integral part of the item as well as methods for the production of courseware using Computer Output Microfilm (COM) to achieve the instructional functions.

3.1.1 Item Diagrams

The relationship between the item block diagram and the CBI systems in which it is embedded is shown in Figure 1. Note that provision has been made for the delivery of courseware using a paper-based or hard copy materials in addition to the microfiche delivery medium. In this case, all verification functions provided by the interface between the microterminal and microfiche reader are accomplished by the "student subsystem". The shaded area of this figure represents the hardware configuration of the item; enclosure "A" represents the provisions for MT/MF subsystem interaction with a CBI system when microfiche is being used for the delivery of courseware; and, the dashed line "B" represents the provisions for this interaction when hardcopy materials are to be used as the courseware delivery medium. In the latter case, those components included in enclosure "A" would not be present in the configuration.

3.1.2 Interface Definition

Two hardware/software interfaces are required for item performance and a third interface, a software-courseware interface, is required for effective integration of the item into the CBI system. While the third interface is not integral to the item, its development as a component of the Advanced Instructional System insures correspondence between directives given by the microterminal and the specific courseware presented on the microfiche reader display to which student responses are expected.

3.1.2.1 Interface Between the MT/MF System and the Advanced Instructional System (AIS)

The interface to the AIS, or other comparable computer-based-instructional systems, is accomplished by the memory module component. This module is designed to plug directly into the microterminal and contains Random-Access-Memory (RAM) to receive data entered into the microterminal by students for transfer to the CBI system. Similarly, data can be downloaded from the CBI system and transferred to the microterminal. Figure A-1 presents a schematic of the memory module circuitry. Table A-1 lists the input/output signals of the memory module and associated voltage levels. Figure A-2 shows the mechanical features of the module. The electrical and mechanical requirements of the memory module must be met by the CBI system in order to effect this interface.

3.1.2.2 Interface Between the Microterminal and the Microfiche Reader (MT/MF I/O)

The MT/MF I/O is accomplished by the performance of the following functions:

a. Fiche Position Verification-the continuous monitoring of the microfiche reader platen by a specially designed transducer which can be mounted on an "off-the-shelf" reader. The transducer output signals are then translated to digital levels which can be transferred to the microterminal to allow verification by software that the reader user is positioning the platen at a proper position as instructed by the microterminal.

b. Lamp Control-this function consists of the control of the projection lamp in the microfiche reader by the microterminal for security applications when portions of information on the fiche are to be unavailable to a student.

Figure 4 is a block diagram of the MT/MF I/O. The mechanical connection of the I/O to microterminal will be into a connector supplied for the memory module. Thus, all mechanical and electrical specifications of the memory module as outlined above must be present in the I/O. In addition, a mechanical and electrical interface will exist to accommodate the memory module in the same manner as is provided for in the microterminal. The multiplex switch will receive control information from the microterminal to direct the flow of data between microterminal and memory module or between the microterminal and microfiche reader as desired. The lamp control function will consist of only a flip-flop to serve as a lamp command latching device to latch on/off commands and a solid state relay which basically contains an optical isolator and triac to switch the lamp.

The design of the platen X and Y positions transducers and signal conversion control is not yet complete. However, Figure 5 is a block diagram of a proposed design alternative that appears most feasible at

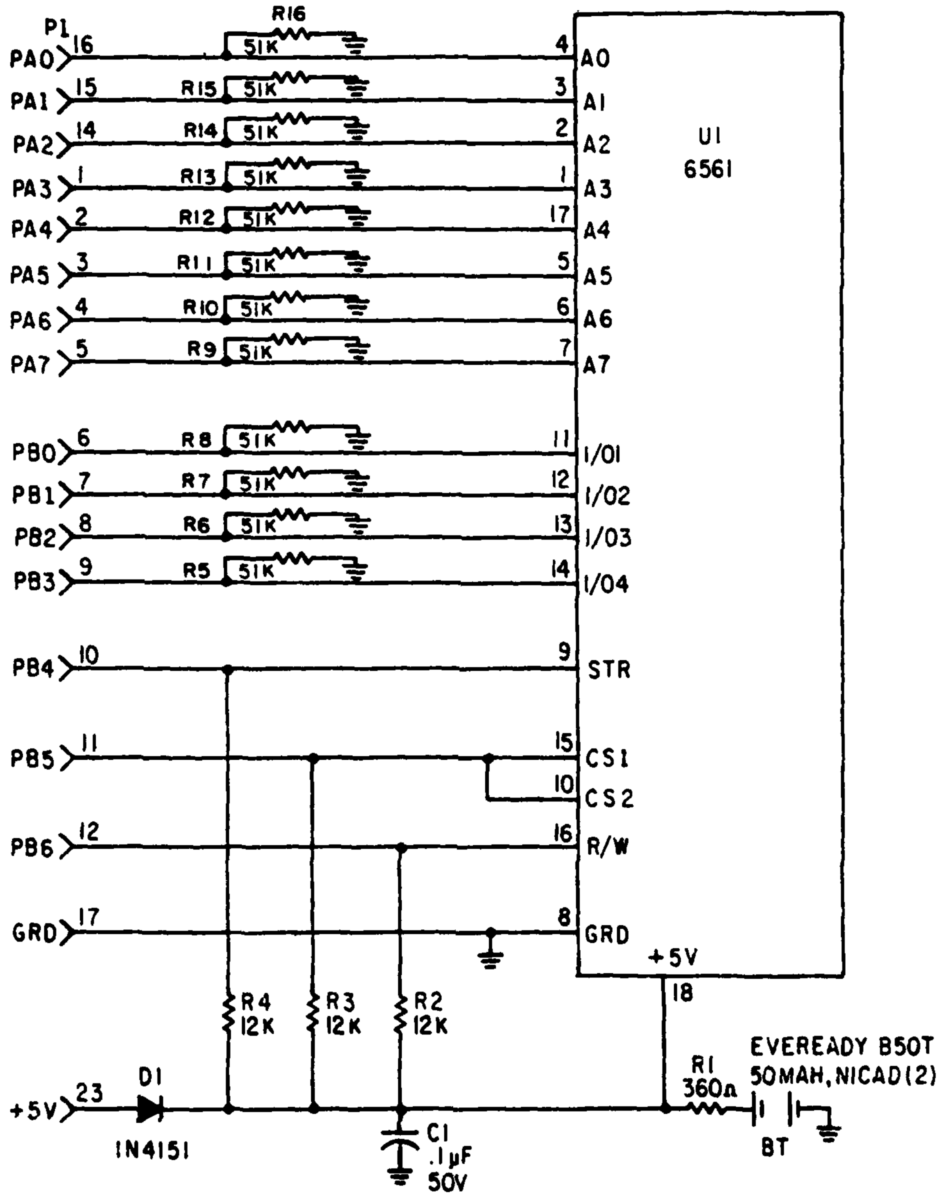


FIGURE A-1. MEMORY MODULE CIRCUITRY

Table A-1.

MEMORY MODULE SIGNALS

Connector Pin	Sig Name	Description
P1-1	Addr 3	Address T = +5V
P1-2	Addr 4	Address T = +5V
P1-3	Addr 5	Address T = +5V
P1-4	Addr 6	Address T = +5V
P1-5	Addr 7	Address T = +5V
P1-6	I/O 1	Data Input/Output +5V/ØV
P1-7	I/O 2	Data Input/Output +5V/ØV
P1-8	I/O 3	Data Input/Output +5V/ØV
P1-9	I/O 4	Data Input/Output +5V/ØV
P1-10	Strobe	Negative Edge +5V to ØV
P1-11	$\overline{\text{CS 1 / CS 2}}$	Chip Select T = ØV
P1-12	R/$\overline{\text{W}}$	Read = +5V Write = ØV
P1-13	NC	--
P1-14	Addr 2	Address T = +5V
P1-15	Addr 1	Address T = +5V
P1-16	Addr Ø	Address T = +5V
P1-17	Ground	
P1-18	NC	--
P1-19	NC	--
P1-20	NC	--
P1-21	NC	--
P1-22	NC	--
P1-23	+5V	
P1-24	NC	--
P1-25	NC	--

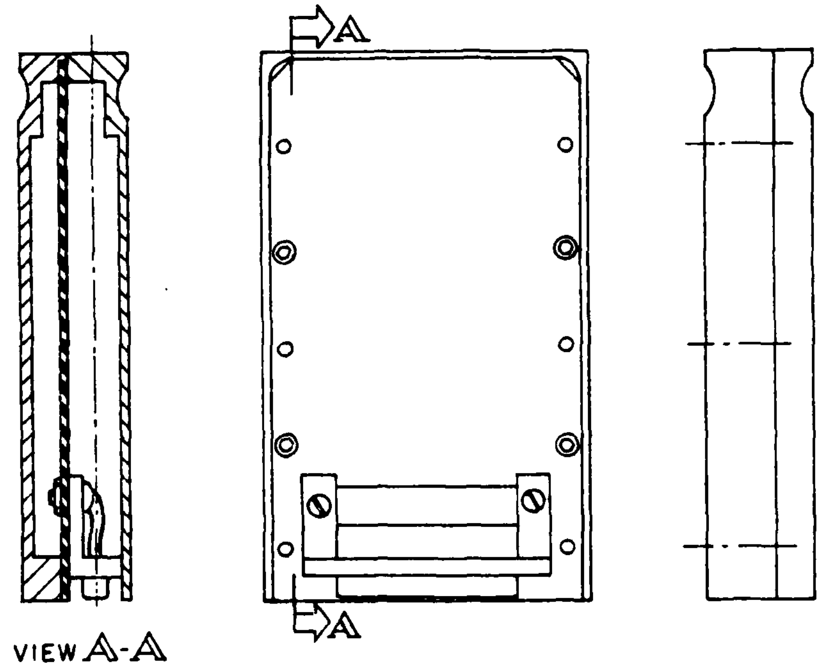


FIGURE A-2. MECHANICAL LAYOUT OF MEMORY MODULE

this stage. The transducers will be linear potentiometers mounted to the platen in a way which permits the slider of the potentiometer (for each axis) to move in accordance with platen motion. The signal conversion control is comprised of analog-to-digital converters monitored by the microterminal via the multiplex switch.

A second alternative design of the platen X and Y position transducers and interface consists of an optical approach. The approach takes advantage of the fact that the COM-produced microfiche have a very high degree of X-Y precision in the recording of each frame. It appears to be practical to add a code to each frame at the right-hand side of the frame that could be "read"--even at very low lamp intensities--to provide either frame, item, and/or unit verification. Such a non-mechanical approach could provide lamp control for high security applications, could be readily adapted to different reader-viewer configurations, and could work at different fiche magnification ratios, without modification.

3.1.2.3 Courseware Interface

The course author would first enter the text of his course into the system using the regular AIS Source Editor, but including additional characters which would key the text to the fiche format, e.g., to delimit paragraphs or to separate question stems, answers, and distractors. After the text has been prepared, the author would use the microfiche layout generator to position the text on the fiche with appropriate margin adjustment, framing, and graphics blocks. After the fiche is formatted, output may be made on either COM or line printer (with automatic test key file or microterminal download file generation), and the materials evaluated. If any errors are detected, then the process could be repeated, with only corrections and updates made at each step. When the lesson is certified, the lesson materials will be available directly, since they are the same ones used to evaluate the lesson.

The microfiche layout editor is depicted in Figure A-3, with the editors and files required to support its use. The CAMIL Source Editor and the Source Text File already exist. The Graphics Editor and Graphics File do not exist, and are not proposed as elements to be included with the current system, but would be appropriate future additions to the system if the services of a COM generator with graphics capability are added. The microfiche layout file is shown as a separate file, but could be incorporated into the CAMIL Source File if that did not cause a conflict with the existing AIS file handling system, and if multiple layouts were not made for the same text file (e.g., multiple versions of a test from the same item pool). For these reasons, it is not suggested that the microfiche layout file be included in the next file. The Test Key File and/or microterminal Download File would be generated for use with the Adaptive Model when the materials are being used for testing or adaptive instruction. In order to use the data in these files, the adaptive model would have to be modified in a manner which will not be capable of being defined until these applications are defined.

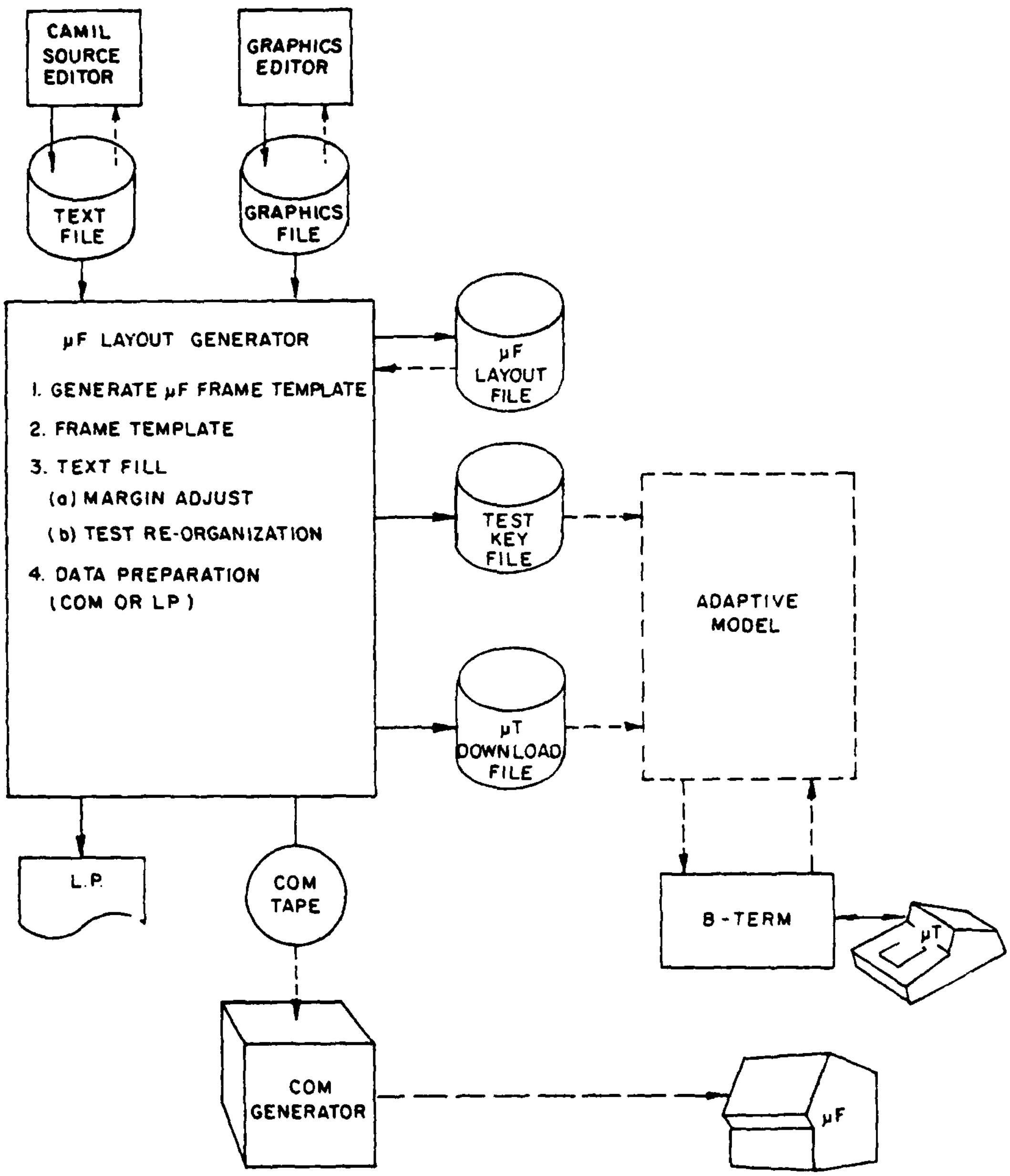


FIGURE A-3 MICROFICHE LAYOUT EDITOR

The Microfiche Layout Editor would use the graphics capabilities of the AIS type A terminal to allow the course author to see and control the format of the text as it is being placed on the fiche, but will automate the actual formatting process by providing margin adjustment and test item randomization. In addition, for testing and adaptive instruction, the editor would generate appropriate data files for use by the microterminal/microfiche system, so that no other program would be needed (except for the Adaptive Model and B terminal firmware modifications) to utilize the microterminal/microfiche system.

When a courseware specialist is using the Fiche Editor, he/she would be presented with a menu page similar to that shown in Figure 7. This menu would allow the specialist to name the files to be used in the COM generation, select the overall fiche format (e.g., 48x-text, 24x-text, etc), insert the fiche title, fill the frames with text, generate the output files, and select frames for format specification. In addition, as an aid to locating frames for further editing, an optional display of the entire fiche, showing frame numbers and status (blank, formatted, or filled) would be available.

If a frame is selected for editing, then the editor would display the page in schematic form, as shown in Figure 8. While in this frame, margins could be specified (top, bottom, left, right) with provisions for text justification if desired; areas of the frame could be reserved for the insertion of graphics and control character features specified (e.g., paragraph indentation as well as indentation and location of question answers and distractors). Text layout would be shown by suitable graphics symbols rather than actual text since the plasma display is not large enough to contain the information for even a workable portion of a frame (i.e., plasma panel is 32 lines x 64 characters vs. 66 lines x 132 characters for fiche). Also, the text editing is to be done elsewhere, without regard to margin justification, while this program is intended to assist in page layout, without regard to textual content.

3.1.3 Major Component List

There are four major components in this item:

a. Microterminal - this component consists of an existing device developed under a previous contract (F33615-77-C-0045) and is included as a part of this item in the same configuration as developed in that contract.

b. Memory Module - this component will consist of an existing device developed under a previous contract (F33615-77-C-0045) or a modified version of the existing device capable of more storage capacity for information exchange between this item and CBI systems.

c. Microfiche Reader - this component consists of a commercially available "off-the-shelf" device which shall be

modified only to the extent required to accommodate the platen transducers and control of the projection lamp. Presently, two readers are being considered. They are the NCR 156-5 COM Reader and the MICRON 750 Reader.

d. Microterminal/Microfiche Reader I/O - this component will consist of all hardware necessary to effect the proper interchange of signals between microterminal and microfiche reader as discussed in paragraph 3.1.2.

3.1.4 Government-Furnished Property List

As a separate task on this contract, 20 microterminals are being constructed of which 10 are to serve as government-furnished equipment for incorporation into this item. The microfiche readers will be government-furnished if the particular model chosen for this item is one of several models that were purchased by the government on a separate contract, F33615-77-C-0057, for evaluation and classroom demonstration purposes.

APPENDIX B

Assembly Drawing
Parts List

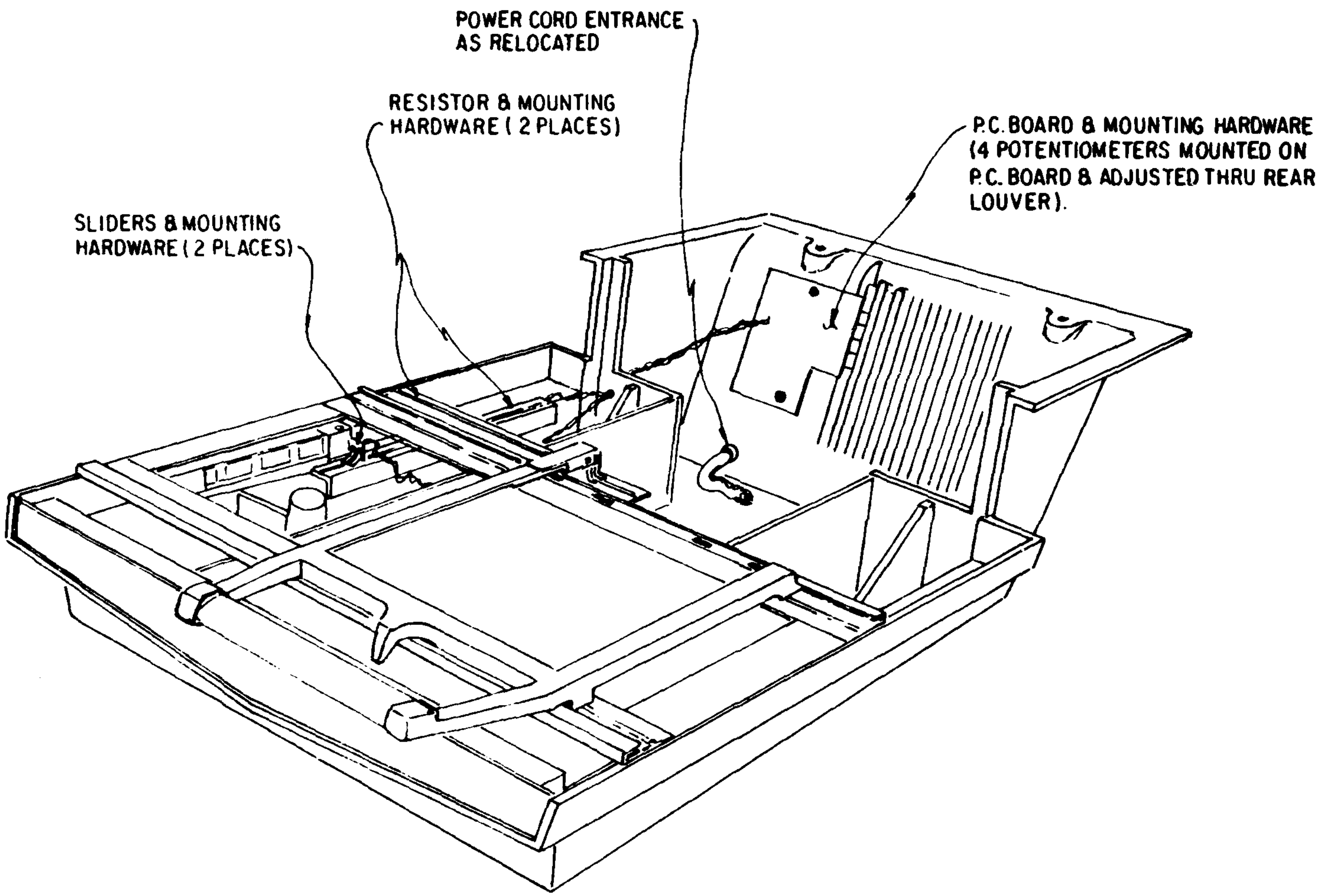


FIGURE B-1
MICRO-FICHE VIEWER MODIFICATIONS
(SHOWN WITH OPTICS AND VIEWING SCREEN REMOVED FOR CLARITY)

Table B-1

MICROTERMINAL/MICROFICHE MODIFICATION
PARTS LIST

Quantity	Unit/Item	Number
1	Adaptor Module	DRI #14139 A
1	Adaptor Module	DRI #14190
1	Connector	CINCH DB-25-P-V
1	Connector	ITT DBK 25 S-V
2	Spacer	DRI #EA14113
2	Spacer locking	DRI #EA14111
2	Pin guide	DRI #EA14114
1	Retainer clip	DRI #EA14112
2	Header	Augat #5P26-10
2	2-56 x 5/16" RH screws	
2	2-56 Lock washers	
2	2-56 Plain nuts	
2	Insulator .015 Mylar .156 ID, 1250 OD	
2	1K 1/4W resistor	
2	5.1K 1/4W resistor	
4	.01 50V Cap	Mallory C12C224M-5UICA
1	MC 14508B 1C	
1	74132 1C	
1	7404 1C	
1	7400 1C	
1	74121 1C	
1	339 Voltage comp.	

Table B-2

MICRODESIGN 4010/4020 MODIFICATION
PARTS LIST

Quantity	Unit/Item	Number
1	PC Board	DRI #14182
1	Relay SIGMA	226REI-5A1
2	100 ohm Potentiometers	Bourns 3299-W-1-101
2	1000 ohm Potentiometers	Bourns 3299W-1-102
4	200 ohm 1/4W Resistors	
2	≃ 20K Linear Potentiometer	Waters #MEL 1350-B-6
1	Cable assembly	Royal Electronics #3217
1	Cable assembly	Royal Electronics #3211
2	Wipers for Waters Potentiometers	
1	Strain Relief	HEYCO 6P-4
1	Spacer, Inner	DRI #14176
1	Spacer, Outer	DRI #14177
1	Resistor Mount	DRI #EA14175
1	Resistor Mount	DRI #EA14172
1	Wiper Mount	DRI #EA14174
1	Wiper Mount	DRI #EA14173
1	Support, Strain Relief	DRI #EA14216
2	Support, PC Board	DRI #EA14217

Miscellaneous Parts

APPENDIX C

Circuit Description and Schematic of Adaptor Module

Appendix C

Circuit Description

The schematics for circuitry used in the microfiche viewer and the adaptor module are combined in Figure C-1.

Rx and Ry are the linear potentiometers (position transducers) installed in the viewer. Resistors R2 and R5 are used to adjust the maximum voltage that is applied to the transducers. Similarly, R7 and R8 control the minimum voltage that results when the carrier is at its extreme XY position. These resistor adjustments provide the "set points" referred to earlier: they establish voltage levels across each potentiometer, and the levels required are derived from "calibration" software programmed into each microterminal.

The solid state relay is installed in one lead of the 110 Vac supply to control the power input to the viewer in response to signals from the microterminal. This is essentially a series ac switch in the viewer and it controls both the lamp and the fan power. The original power switch must still be used to control the high/low intensity setting of the lamp.

Adaptor Module

A single Analog-to-Digital converter is used to convert both the X and Y voltage levels that define the position of the microfiche platen to digital signals. The MC8BC converter used is an eight bit monolithic device that requires an external voltage comparator and a clock generator. The analog voltages obtained from the X and Y transducers in the viewer are applied to the inverting inputs of two identical voltage comparators. The Adaptor Module operates as follows: When a "start convert" pulse is received from the microterminal it is stretched by the one-shot multivibrator at U7. This is to prevent a race condition at the flip-flop formed by U3A and U3B.

The start pulse sets this flip-flop which in turn enables the clock generator formed by the oscillator at U3D and gate at U3C. The counter in the A/D converter is reset to zero. If the D/A converter's output voltage is less than the analog input voltage the counter is incremented and the D/A output increases by one LSB. These comparisons continue until the D/A output is equal to the analog signal, at which time the voltage comparator output switches and resets the flip-flop. This stops the clock generator and the binary value of the counter (proportional to the voltage on a potentiometer) is preserved in the tri-state latch.

The XY SELECT input controls which voltage comparator is being used to stop the counter. In this manner one A/D converter can convert both the X and Y values to binary values.

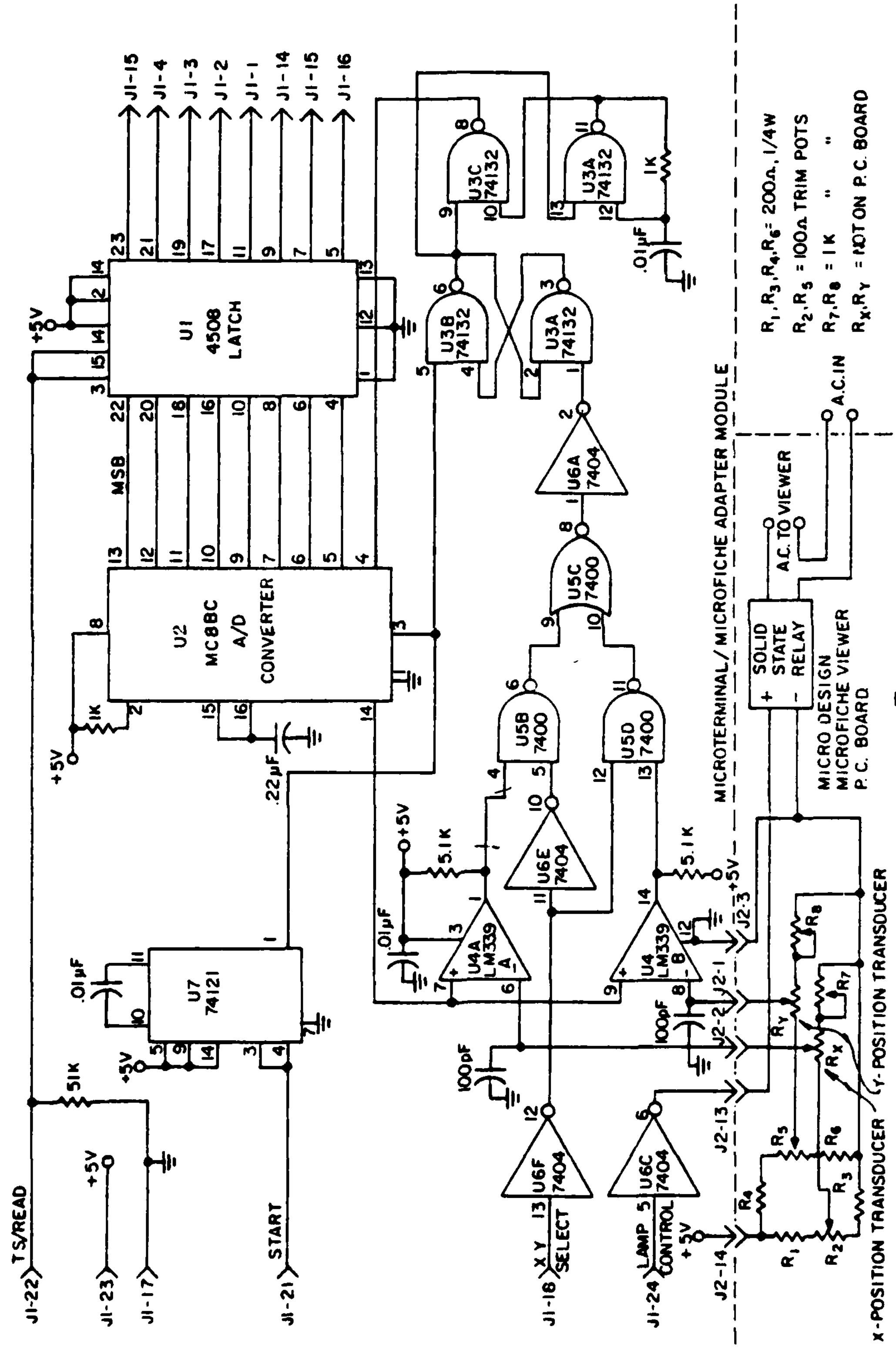


FIGURE C-1. MT/MT I/O CIRCUITRY

The TS/READ signal controls the tristate output of the latch. They are normally held in the high impedance state, which allows the adaptors and the memory module to time share the calibration.

Calibration

Calibration of the position monitoring system for each microterminal/microfiche consists of adjusting the upper viewer combination and lower limits of the X and Y voltages to correspond with the rows and columns on the microfiche (the set points). A sub-routine has been included in the software to facilitate this procedure. This sub-routine, in effect, allows the microterminal to display a hexadecimal representation of the respective voltages on the potentiometers that correlate with known fiche frame locations. This sub-routine is accessed from the keyboard by storing a decimal 12 (hexadecimal C) at address Ø in the memory module.

When the module is inserted into the microterminal, the display will continously show in the hexadecimal format the X voltage in the two left-hand digits and the Y voltage in the two right-hand digits of the display. Place a microfiche into the corner, making sure it is positioned properly, and align frame G-9 for viewing. Adjust R2 to set the X voltage to E-6 and R5 to adjust the Y voltage to B-8. Re-align the carrier to view frame A-1 and adjust R7 to set the X voltage to 1-B and R8 to set the Y voltage to #-A. Repeat the above procedure to eliminate interaction until all stated values of the pots are ± Ø. The desired voltage values for other positions of the carrier are shown in Table C-1. All voltages should be within ± .02 volt of this table.

Finally, position the index grid to correspond to the frame being viewed.

This procedure must be repeated any time the microterminal, the adaptor module, or the microfiche viewer is replaced or when any related maintenance is performed on them.

Table C-1. Alignment

ALIGNMENT OF MICROFICHE VIEWER INTERFACE
LOAD ADDRESS Ø OF MEMORY MODULE WITH C(HEX)
PLUG INTO MICROTERMINAL AND ADJUST
TRIM POTS ACCORDING TO FOLLOWING TABLE

STEP #	Frame	Position	Adjust	Voltage
1	Col.	9	R2	E6
2	Col.	1	R7	1B
3	Row	G	R5	B8
4	Row	A	R8	3A
	Header		R8	25

Check frames according to following table:

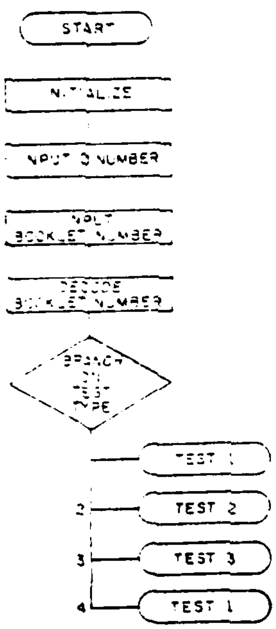
		Col.	1	2	3	4	5	6	7	8	9
Y	X		1B	35	4F	67	80	1A	B4	CD	E6
Header											
A			25								
B			3A								
C			64								
D			79								
E			8E								
F			A3								
G			B8								

APPENDIX D

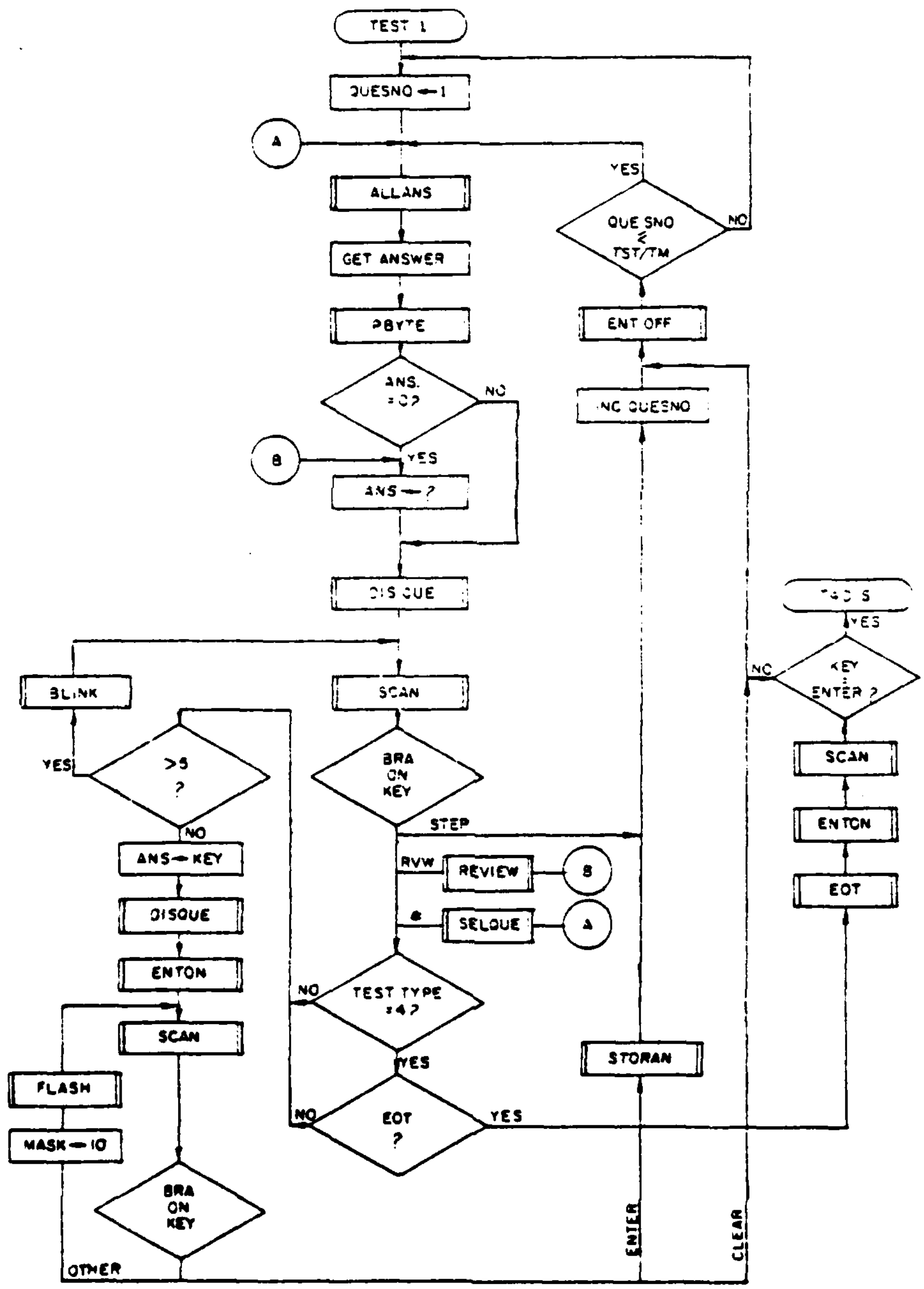
Software Functional Flow Diagrams

MICROTERMINAL MAIN
PROGRAM LOOP

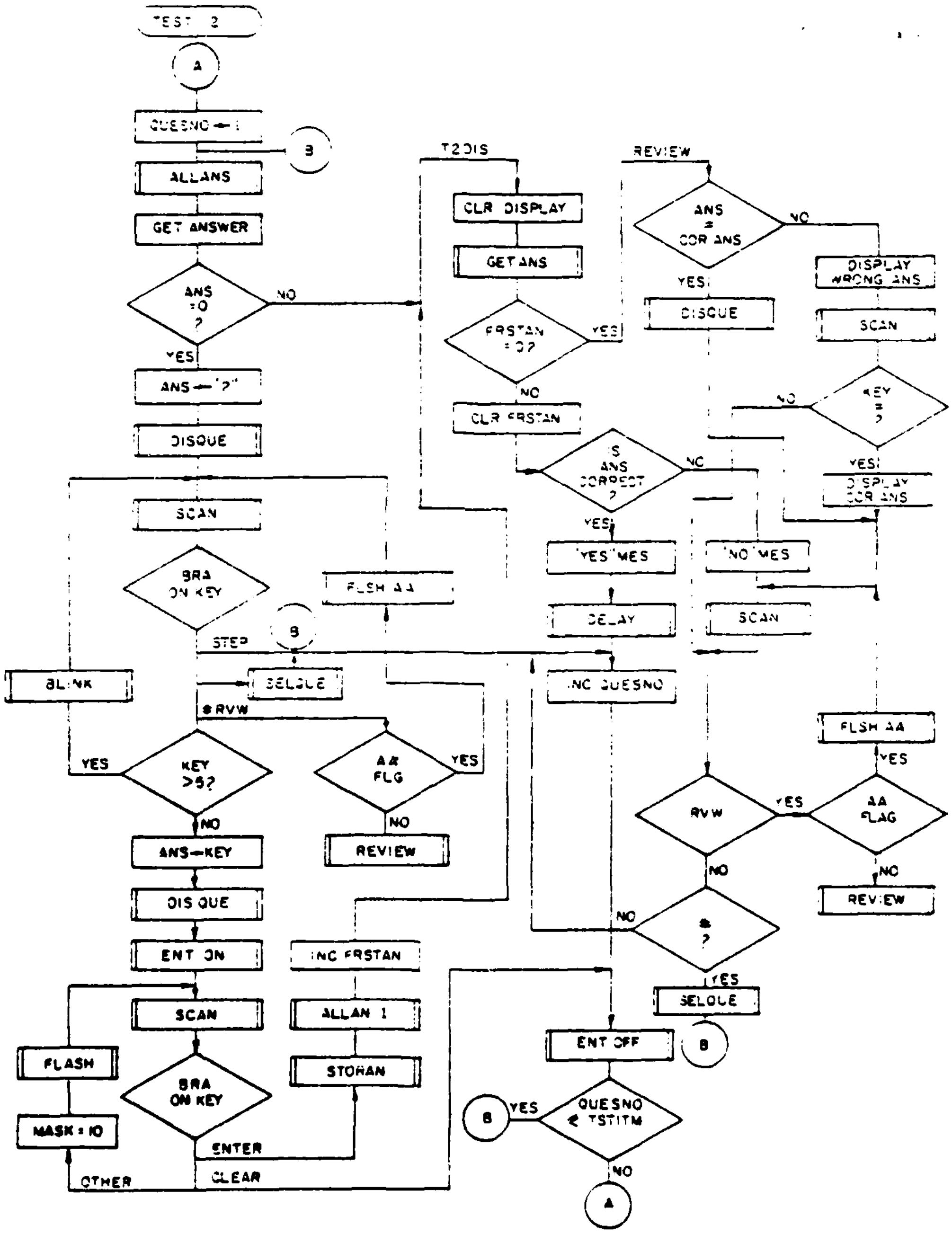
U022.SRC



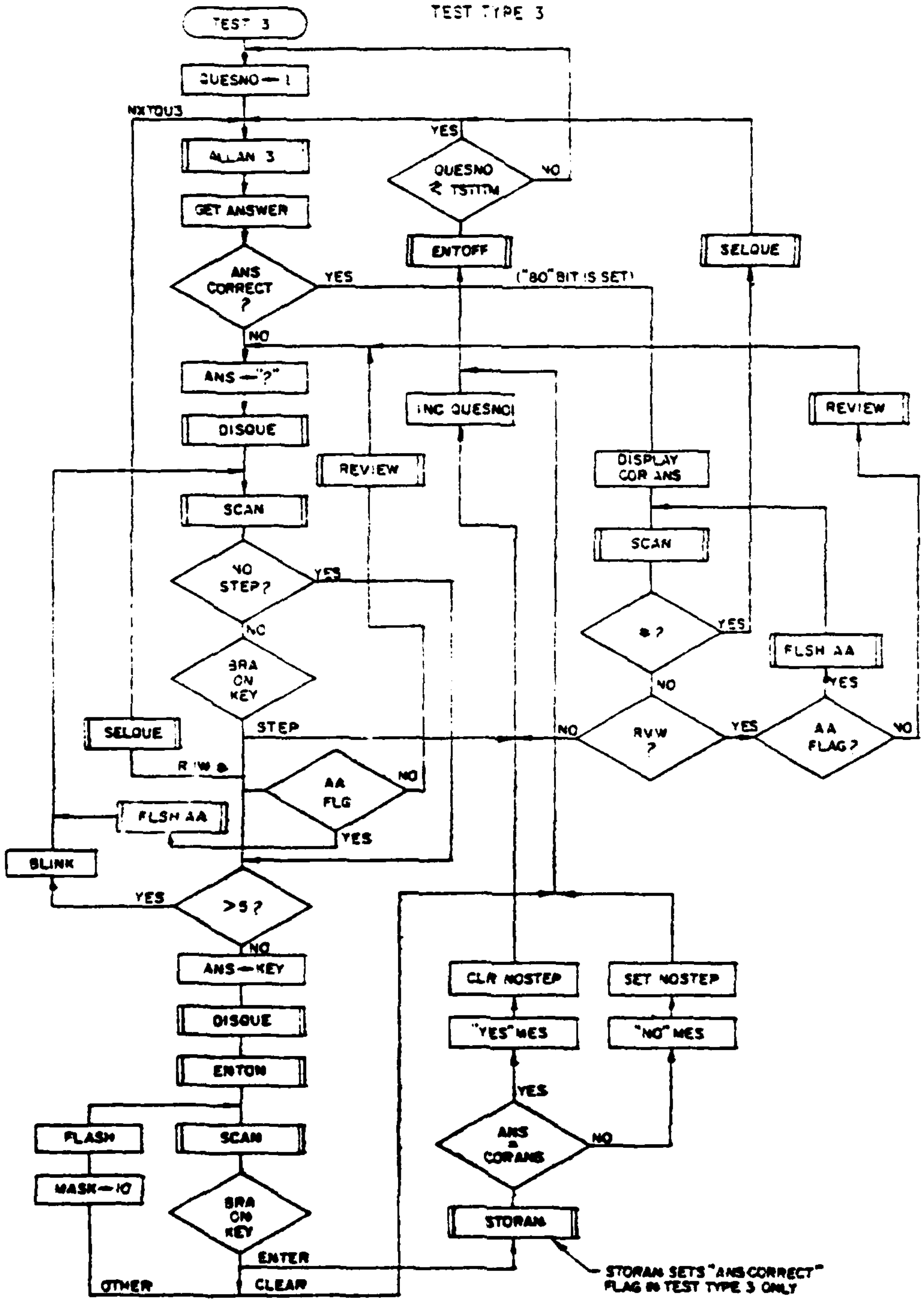
TESTS TYPES 1 AND 4



TEST TYPE 2



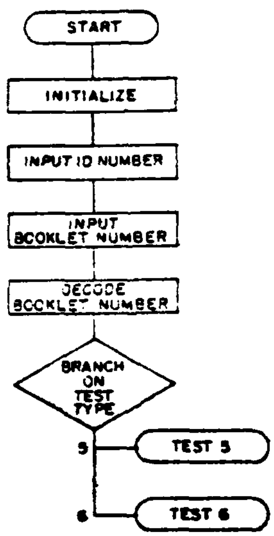
TEST 2
A
QUESNO ← 1
B
ALLANS
GET ANSWER
ANS =0 ?
NO
YES
ANS ← '?'
DISQUE
SCAN
BRA ON KEY
STEP
B
BLINK
SELQUE
≠RVW
FLSH AA
YES
KEY >5?
NO
AA≠ FLG
YES
NO
REVIEW
ANS←KEY
DIS QUE
ENT ON
SCAN
BRA ON KEY
FLASH
MASK=10
ENTER
CLEAR
OTHER
INC FRSTAN
ALLAN 1
STORAN
T2DIS
CLR DISPLAY
GET ANS
FRSTAN =0?
YES
NO
CLR FRSTAN
IS ANS CORRECT ?
NO
YES
YES MES
NO MES
DELAY
SCAN
INC QUESNO
ENT OFF
B
QUESNO ≤ TSTITM
YES
B
NO
A
REVIEW
ANS = COR ANS
NO
YES
DISQUE
DISPLAY WRONG ANS
SCAN
KEY = ?
NO
YES
DISPLAY COR ANS
FLSH AA
YES
RVW
YES
AA FLAG
NO
NO
REVIEW
NO
≠ ?
YES
SELQUE
B



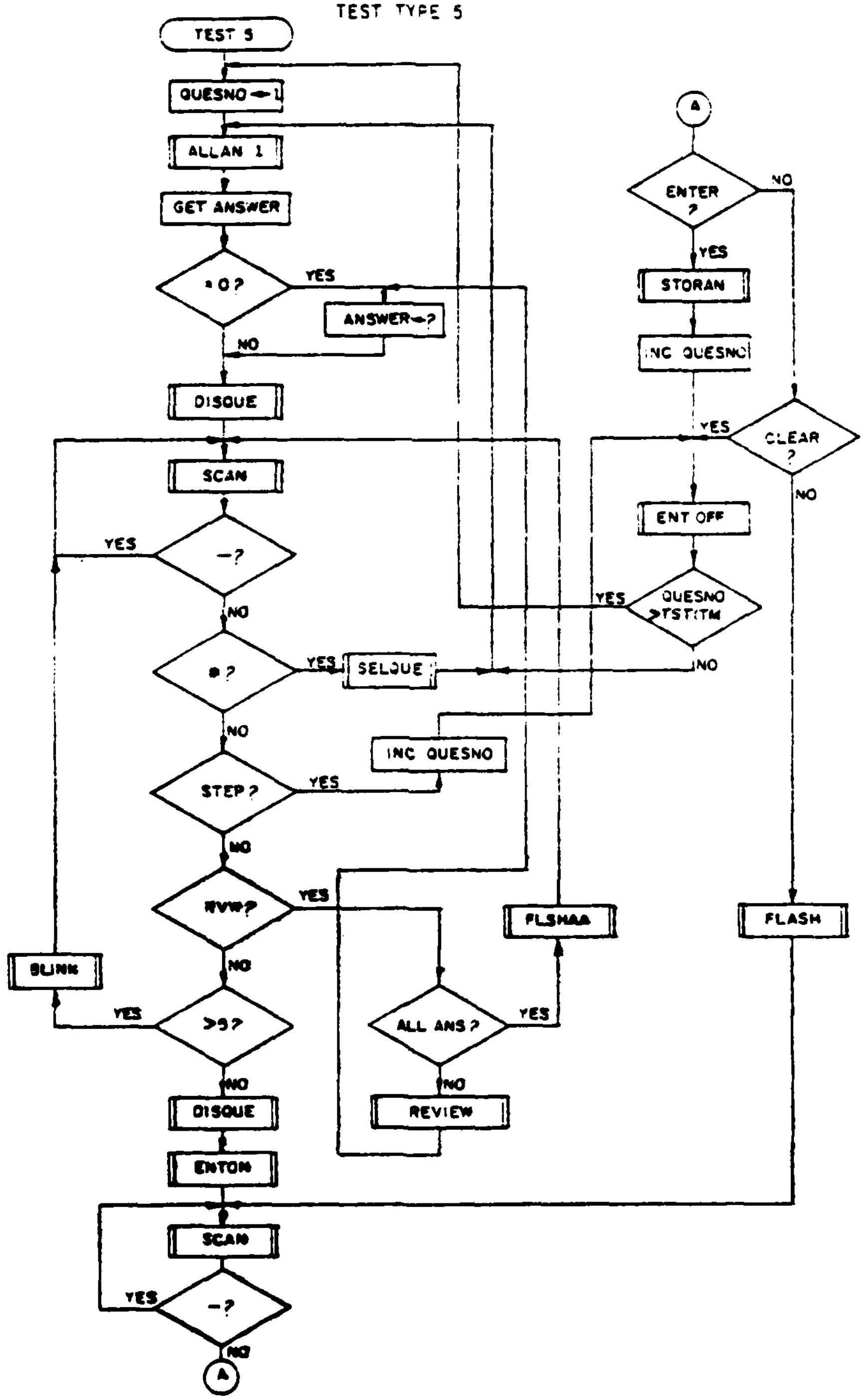
TEST TYPE 3
TEST 3
QUESNO ← 1
NXTQU3
ALLAN 3
GET ANSWER
ANS CORRECT ?
YES
NO
QUESNO ≥ TSTITM
ENTOFF
("80" BIT IS SET)
SELQUE
ANS ← "?"
DISQUE
INC QUESNO
REVIEW
DISPLAY COR ANS
SCAN
NO STEP?
BRA ON KEY
STEP
SELQUE
AA FLG
FLSH AA
BLINK
>5 ?
RVW ?
AA FLAG ?
ANS ← KEY
ENTON
FLASH
MASK ← 10
CLR NOSTEP
SET NOSTEP
"YES" MES
"NO" MES
ANS = COR ANS
STORAN
ENTER
CLEAR
OTHER
STORAN SETS "ANS CORRECT" FLAG IN TEST TYPE 3 ONLY

MICROFICHE/MICRO TERMINAL
MAIN PROGRAM LOOP

FICH ◆ SRC

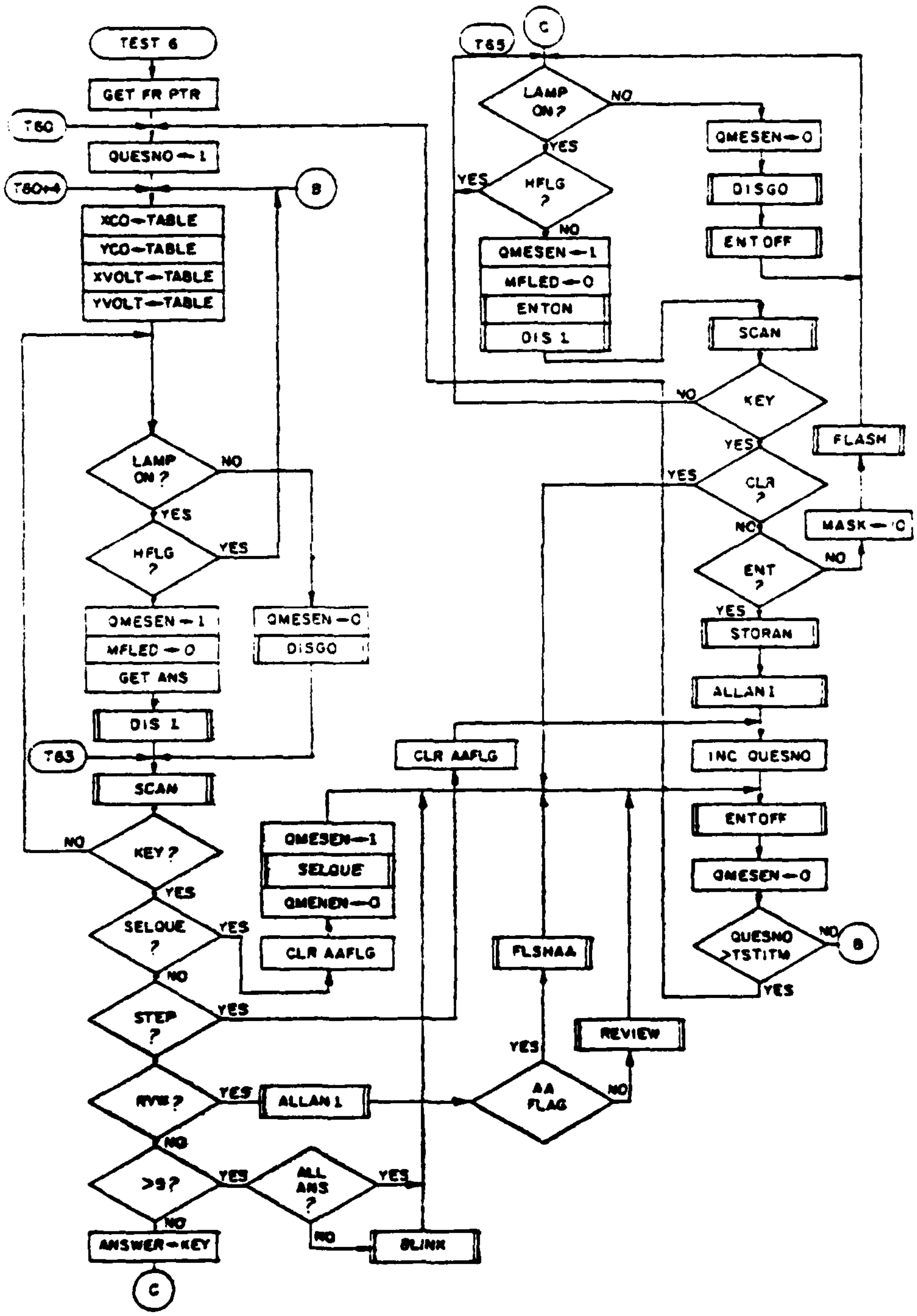


TEST TYPE 5



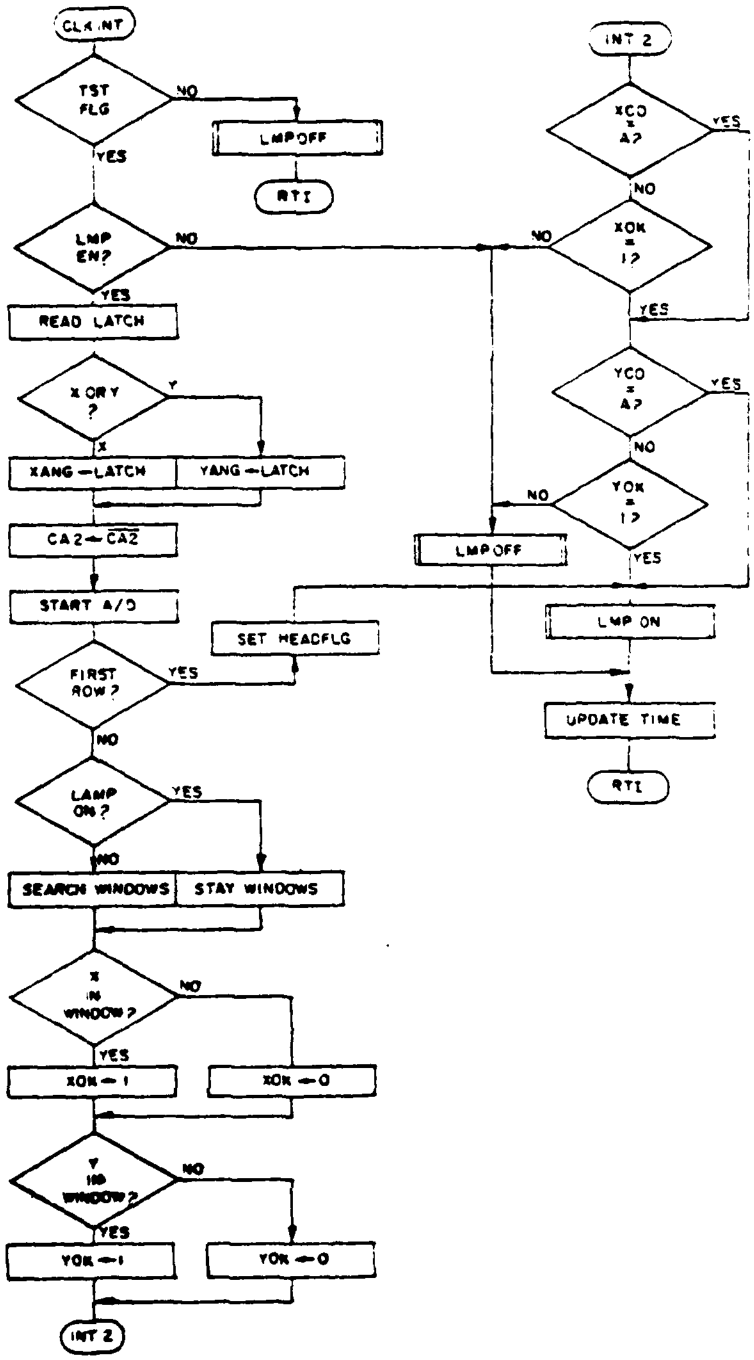
TEST 5
QUESNO ← 1
ALLAN 1
GET ANSWER
= 0 ?
YES
NO
ANSWER ← ?
DISQUE
SCAN
− ?
YES
NO
?
YES
SELQUE
NO
STEP ?
YES
INC QUESNO
NO
RVW ?
YES
NO
> 9 ?
YES
BLINK
NO
ALL ANS ?
YES
NO
REVIEW
FLSHAA
DISQUE
ENTON
SCAN
− ?
YES
NO
A
A
ENTER ?
NO
YES
STORAN
INC QUESNO
CLEAR ?
YES
NO
ENT OFF
QUESNO > TSTITM
YES
NO
FLASH

TEST TYPE 6

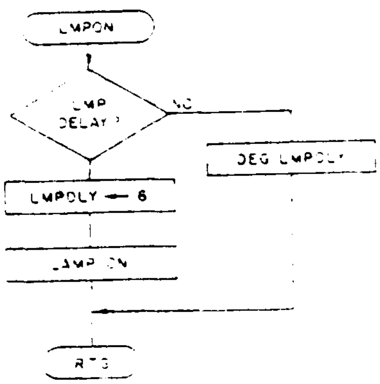


TEST 6
GET FR PTR
T60
QUESNO ← 1
T60+4
B
XCO ← TABLE
YCO ← TABLE
XVOLT ← TABLE
YVOLT ← TABLE
LAMP ON ?
NO
YES
HFLG ?
YES
QMESEN ← 1
MFLED ← 0
GET ANS
DIS 1
QMESEN ← 0
DISGO
T63
SCAN
KEY ?
NO
YES
SELQUE ?
YES
NO
QMESEN ← 1
SELQUE
QMENEN ← 0
CLR AAFLG
STEP ?
YES
RVW ?
YES
ALLAN 1
NO
>9 ?
YES
NO
ALL ANS ?
YES
NO
BLINK
ANSWER ← KEY
C
T65
C
LAMP ON ?
NO
YES
HFLG ?
YES
NO
QMESEN ← 1
MFLED ← 0
ENTON
DIS 1
QMESEN ← 0
DISGO
ENTOFF
SCAN
KEY
NO
YES
FLASH
CLR ?
YES
NO
MASK ← 0
ENT ?
NO
YES
STORAN
ALLAN1
CLR AAFLG
INC QUESNO
ENTOFF
QMESEN ← 0
QUESNO >TSTITM
NO
B
YES
FLSHAA
REVIEW
AA FLAG
YES
NO

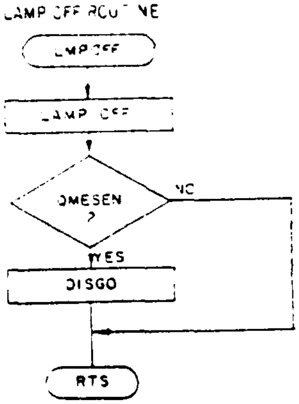
CLOCK INTERRUPT ROUTINE



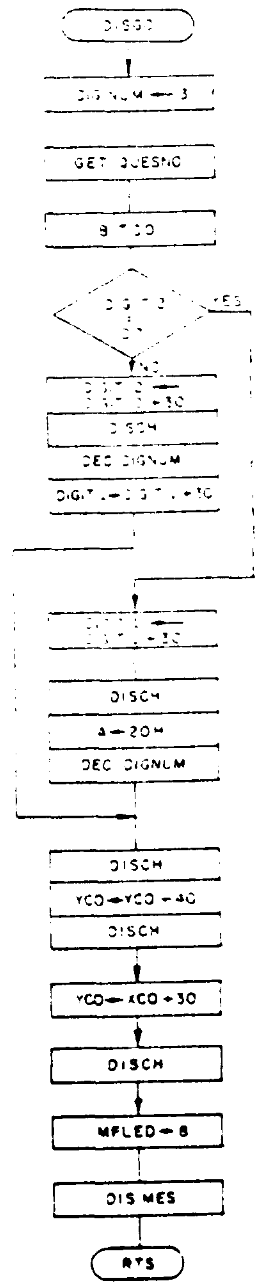
LAMP ON ROUTINE



LAMP OFF ROUTINE



DISPLAY FRAME & MESSAGE



APPENDIX E

Description of the EDITFICHE Program Flow Diagram (Figure 5)

Appendix E

The user types in the 10 character title of the microfiche for which layout specifications are to be given. For a given microfiche, either (a) the layout specifications have never been given, or (b) they have been given but must be modified. For ease of discussion a set of layout specifications for a microfiche will be referred as "the microfiche", and if situation (a) occurs, a "new microfiche", or just "new fiche" and if (b) occurs, an "old fiche".

The user keys in "n" or "o" to signify new or old fiche, respectively. A set of fixed default layout specifications for a fiche resides within EDITFICHE. If the fiche is new, the program informs the user, as discussed in subsection B, what these default specifications are and that it intends to use them unless otherwise directed. If the fiche is old, this means that a set of layout specifications will already have been given and stored as a record in an indexed sequential file of the AIS data base.

Therefore, if the user enters "o", these will be retrieved for use and modification, by EDITFICHE. When the user terminates the session on EDITFICHE, the most current set of specifications for the fiche (which are represented internal to the program) are then written out to the AIS file FICHENAMES, for retrieval and modification at a later time if necessary.

An image of the current global layout specifications for the fiche is presented visually to the user. If the fiche is new, the <u>default</u> set of specifications is used and the fiche image drawn accordingly. If the fiche is old, the retrieved set of specifications will be used.

If the fiche is new, the user must indicate the acceptability of the specifications. If unacceptable, the user must enter values for the fiche reduction factor and number of frames per row/column. The fiche image is then redrawn.

If the fiche is old, the image shown will also indicate the layout specification status of each frame. These are (a) not given, (b) given but not used to fill frame within text, or (c) used to fill frame within text.

A menu is displayed beneath the fiche image and the user selects an option. These are:

1. Specify layout for frame(s).

2. View pseudo-filled frame(s).

3. Fill frame(s) with formatted source text.

4. Print content of filled frame(s).

5. Generate tape for COM.

6. Exit.

The user then specifies which frame(s) if any, are to be operated on under the option selected.

The program enters that segment which executes the option selected. The operation of each segment is described below.

Segment #1. The user is shown an image of a frame which indicates current boundaries for text and graphics areas. Beneath this image, the user is shown a set of commands for modifying margins within a frame (left, right, top, bottom) and for adjusting the shape of various text and graphics areas within these margins. After each command has been keyed in, the image of the frame will be adjusted. Either NEXT or BACK must be pressed. If BACK is pressed, the program returns to the menu page.

If the NEXT key is pressed, the command keys are disabled, and the frame image will be overlayed with multiple occurrences of a special graphics character. Each occurrence of this character corresponds to a non-blank character of the source text. When this view of the pseudo-filled frame is completed, the user presses NEXT or BACK.

If NEXT is pressed, a second time, margin adjustment, and pseudo-filling is repeated for the next frame, if any. If there are no more frames, the programmer returns to the menu page.

If after NEXT has been pressed, BACK is pressed, the overlayed characters are erased, the command keys restored, and the user can again modify the margins or text graphics boundaries for the same frame.

Segment #2. The user is presented with a simulated view of a frame, as described in Segment 1. After simulation of each frame, the user must press NEXT or BACK. If NEXT is pressed, the next frame in the list is pseudo-filled. If there are no more frames to be pseudo-filled and viewed, the program enters Segment 3. If BACK is pressed, the overlayed characters will be erased and Segment 1 re-entered beginning with the current frame.

Segment #3. Each frame is associated with a section of a coded (i.e., text) SCOPE file. This segment fills each specified frame according to layout specifications. After the specified frames have been filled, the user must press NEXT or BACK. If the user presses NEXT, then Segment 4 is entered. If BACK is pressed, the program returns to the menu page.

Segment #4. This segment produces hardcopy of the formatted content of each of the specified frames. Upon completion, the user must press NEXT or BACK. If NEXT is pressed, Segment 5 is entered. If BACK is pressed, the program returns to the menu page.

Segment #5. This segment operates on the SCOPE file which contains formatted text for the entire fiche. It encodes the text into EBCDIC characters and writes the file to a tape, which is then used to generate the actual fiche. After this batch mode job has been initiated, the user must press NEXT or BACK. NEXT takes the user to Segment 6.

Segment #6. This segment writes on the new or updated layout specifications to the file FICHENAMES. After execution the user must press BACK or NEXT. NEXT terminates the program. BACK re-starts the program so that another fiche can be edited.

END

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AD-A090 974 DENVER RESEARCH INST CO F/G 5/9
MICROTERMINAL/MICROFICHE SYSTEM FOR COMPUTER-BASED INSTRUCTION--ETC(U)
OCT 80 J P KOTTENSTETTE, D A STEFFEN F33615-78-C-0046
UNCLASSIFIED AFHRL-TR-80-17 NL

2 of 2

SUPPLEMENTARY

INFORMATION

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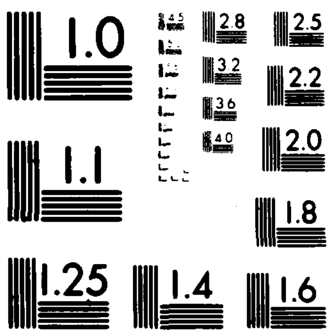

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

SUPPLEMENTARY

INFORMATION

AD-A090 974

Errata

DEPARTMENT OF THE AIR FORCE
AIR FORCE HUMAN RESOURCES LABORATORY (AFSC)
BROOKS AIR FORCE BASE, TEXAS 78235

16 JAN 1981

REPLY TO ATTN OF: TSR

SUBJECT: Removal of Export Control Statement

TO: Defense Technical Information Center
Attn: DTIC/DDA (Mrs Crumbacker)
Cameron Station
Alexandria VA 22314

1. Please remove the Export Control Statement which erroneously appears on the Notice Page of the reports listed [redacted]. This statement is intended for application to Statement B reports only.

2. Please direct any questions to AFHRL/TSR, AUTOVON 240-3877.

FOR THE COMMANDER

Wendell L Anderson

WENDELL L. ANDERSON, Lt Col, USAF
Chief, Technical Services Division

1 Atch
List of Reports

Cy to: AFHRL/TSE